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Final report

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Contents

Public summary	1
Keywords	1
Introduction	2
Methodology	3
Results and discussion	4
<i>Key principles</i>	4
<i>Practical steps for project teams</i>	6
<i>Recommendations for project funders</i>	7
<i>Literature review</i>	8
<i>Review of recent RD&E projects</i>	10
<i>Cross-RDC online survey</i>	10
<i>Focus groups</i>	12
<i>Co-design workshop</i>	14
<i>Pre-mortem workshops</i>	14
Outputs	16
Outcomes.....	18
Monitoring and evaluation	19
Recommendations for Phase 2	20
Refereed scientific publications.....	21
Intellectual property	21
Acknowledgements	21
Appendix 1: Stakeholder engagement plan.....	22
Appendix 2: Risk register	25
Appendix 3: Monitoring and evaluation plan	29
<i>Program logic</i>	29
<i>Project M&E scope</i>	30
<i>Performance expectations, data collection and analysis</i>	31
<i>Reporting, learning and continuous improvement</i>	32
Appendix 4: Literature review	33
<i>Objectives</i>	33
<i>Emerging themes from the literature</i>	33
<i>Documents reviewed</i>	35
Appendix 5: Review of recent RD&E projects.....	75
<i>Themes from the review</i>	75
<i>Recommendations</i>	75
<i>References</i>	92
Appendix 5a: Adoption pathways.....	93

Appendix 5b: Proposed templates	100
<i>Project proposal template</i>	100
<i>Project proposal assessment criteria</i>	102
<i>Report template</i>	103
Appendix 5c: Project categories and success factors	104
<i>Categories of projects and indicators of success</i>	104
<i>Contributing factors for ‘success’</i>	107
<i>Co-design logic</i>	109
Appendix 6: Cross-RDC online survey.....	110
<i>Summary</i>	110
<i>Results</i>	113
Appendix 7: Focus groups.....	140
<i>Background</i>	140
<i>Findings by questions</i>	142
<i>Focus group participants</i>	149
Appendix 8: Co-design workshop	150
<i>What we’ve learnt so far</i>	150
<i>What did you whole-heartedly agree with?</i>	151
<i>What did you disagree with?</i>	152
<i>What’s missing?</i>	153
<i>Comments on the quadrant framework</i>	154
<i>Principles and steps to get there</i>	155
Appendix 8a: Pre-reading material.....	160
<i>Theme 1: Co-innovation/ agricultural innovation system perspective</i>	160
<i>Theme 2: Collaboration</i>	161
<i>Theme 3: Evidence driven</i>	161
<i>Theme 4: Resourcing</i>	161
<i>Some questions for you to ponder before the co-design workshop</i>	162
<i>Conclusion</i>	162
Appendix 9: Pre-mortem workshops.....	163
1. <i>End-users</i>	163
2. <i>Project Reference Group</i>	166
Appendix 9a: Pre-reading material.....	169
<i>Key principles</i>	169
<i>Potential implications for project funders</i>	170
<i>Practical steps for the project team</i>	170
<i>Appendix 9a (i): Design thinking</i>	172
<i>Appendix 9a (ii): Co-design quadrant</i>	173

<i>Appendix 9a (iii): Theory of change</i>	174
<i>Appendix 9a (iv): Agile project management</i>	177
Appendix 10: Participant evaluation.....	178

Public summary

How can we get greater adoption of the outcomes from Research, Development and Extension (RD&E) projects? This question has perplexed us for decades, and it seems there are no simple silver bullets. It's a complex problem but through this project, 'Designing the integration of extension into research projects' we were able to distil seven principles for obtaining greater adoption of outcomes from RD&E.

The project was undertaken by a joint team led by John James (Enablers of Change), Denise Bewsell (Scarlati) and Jeff Coutts (Coutts J&R). We worked closely with the nine project co-funders: Hort Innovation, Cotton Research and Development Corporation (RDC), Wine Australia, Fisheries RDC, Dairy Australia, Australian Eggs, AgriFutures, LiveCorp, and NSW DPI.

Data was collected from a range of sources – literature, recent projects, an online survey and focus groups – and used the emerging themes in a co-design process. This helped generate an initial large list of principles which were then summarised and prioritised. The resultant seven principles are:

- Use a systems perspective,
- Use human-centered design,
- Involve end-users,
- Use an appropriate level of co-design,
- Design for impact,
- Use agile management, and
- Communicate and engage effectively.

Practical steps that project teams can use to implement the principles were then provided. Recommendations were made for project funders, namely: encourage greater cross-RDC collaboration, use programs of work, refine funding application processes, consider longer project durations, update project documentation, undertake capability building, provide adequate project resourcing, and offer remuneration for end-users.

Recommendations were also made for how this new approach could be piloted in a Phase 2 project, namely:

- Nominate and select Phase 2 participants,
- Develop and trial a facilitated co-learning journey,
- Co-design a theory of change for the Phase 2 project,
- Develop a detailed implementation guide,
- Trial and test different templates,
- Develop a reflective learning process,
- Design and deliver a cross-RDC capability building program,
- Explore processes for greater cross-RDC collaboration, and finally,
- Explore remuneration for end-users.

Keywords

Extension, adoption, practice change, impact, co-design, co-innovation, RD&E.

Introduction

One of the most critical aspects to successful adoption of research generated knowledge and innovation is engagement between the various actors in the system. Connecting the problem/opportunity to the “right” research question/s and delivering the answer/s (knowledge/innovation) back to the target audience, while simple in theory, in reality is difficult to achieve. The RD&E system within the Australian agricultural sector is incredibly complex represented by dozens of industries, multiple research funders, research and extension providers, industry representative groups, farmer networks, supply chain actors and individual primary producers.

Although there are various methodologies available to identify and work towards finding solutions to problems across agricultural commodities, RDCs still traditionally contract projects that have a relatively narrow focus on research and development followed by extension. The RDC framework has changed little since their inception, with business units being divided into disciplines such as corporate communications, R&D, extension, trade, and marketing. This can exacerbate the continuation of investing in projects of a certain discipline or following a traditional linear approach to research and adoption.

The recent trend to incorporate innovation systems and end-user design approaches (MLA design principles, Food Agility CRC, Council of RDC’s Climate Initiative, AgriFutures Challenge Led and Open Innovation project) have fostered thinking into approaches that are novel, multidisciplinary, end-user focused and innovative. While these approaches differ from traditional RD&E, they still require the core extension capacities such as facilitation, information access, capacity building and stakeholder engagement. These approaches tend to operate at a strategic level, at scale and for maximum impact.

There is a gap in understanding and providing practical insights to build-in rather than bolt-on core extension capacities to research projects and a ‘how to’ methodology for researchers which will be flexible enough to support a range of project approaches and that support researchers optimising the adoption and impact of their research efforts.

The project *Designing the integration of extension into research projects* aims to influence greater change via RD&E. Hort Innovation and eight other collaborating organisations aim to improve the capacity for primary producers, researchers and extension providers to engage and develop plans together to achieve greater adoption and impact.

The objectives of this project are to ensure that:

- Researchers and extension practitioners who are involved in the project increase their knowledge, attitude, skill, aspiration and practice (KASAP) in applying an impact pathway approach to their work.
- Researchers and extension officers are actively engaged in the design of a theory of change that will best inform the pathways to adoption and impact.
- A practical co-designed model/ process and guidelines of a theory of change is developed. This model will be ready to pilot with researchers and extension practitioners for levy funded projects (Phase 2).

Methodology

This project used a mixed methods research approach, primarily using co-design to guide and underpin the research. A **literature review** was conducted and a collection of 30 documents was reviewed, sourced from both the published and grey literature to better understand current approaches to influencing greater change via RD&E, including impact pathways, co-innovation and co-design. A desktop review explored the current approaches being used by the RDCs to incorporate extension into their RD&E projects. An **online survey** gathered both quantitative and qualitative data from almost 250 RD&E practitioners and other key stakeholders. A series of six **focus groups** using semi-structured questions was conducted with 30 participants to explore the emerging themes from the research. One-on-one **interviews** were conducted with key individuals to complement the data being collected. An online **co-design workshop** was conducted with 30 RD&E practitioners and key stakeholders to develop the key principles and implementation steps. Potential risks and flaws in these were identified through two **pre-mortem workshops** with selected end-users and the project reference group. Based on all this input, the seven key principles and steps required for their implementation were developed, as shown in **Figure 1**.

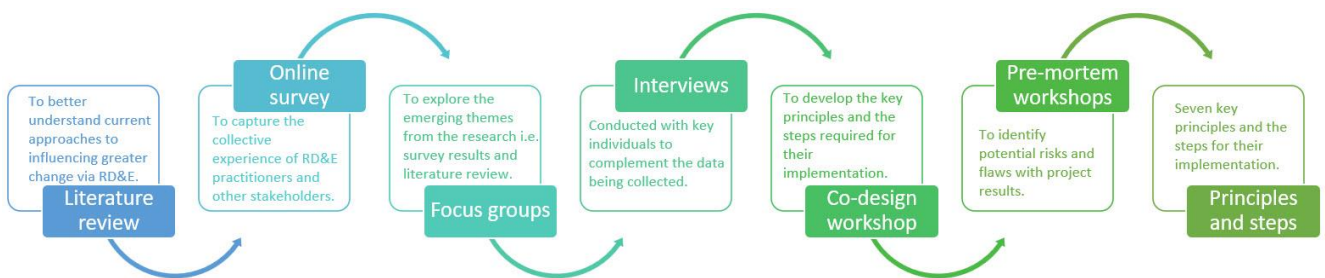


Figure 1. The methodology used for this project.

Results and discussion

The data gathered was used to develop the following seven key principles and implementation steps. The subsequent sections provide the principles and implementation steps. In the Recommendations section (page 20) there are details on how the new approach can be piloted in a Phase 2 project.

Key principles

1. **Use a systems perspective.** A system is a human construct to help us better understand how a set of elements work together to form a unified whole, often involving processes and practices. We need to be cognisant that we're working in an Agricultural Innovation System where many of the elements are interconnected and where feedback loops are important. Additionally, we're often working with multiple stakeholders along the value chain.

The challenge in RD&E projects is to use a systems approach that is appropriate for the level of systems complexity being dealt with. Practice change requires connecting the biophysical and human behaviour elements of the system, which increases systems complexity. For example, a complicated system has many working parts, but we have some understanding of those parts and can attempt to make sense of it. On the other hand, a complex system has many unknown parts and as such we can only guess as to how it works. RD&E trying to deliver change in a complicated system is usually successful as the system can be understood more fully. On the other hand, RD&E trying to deliver change in complex systems faces a greater challenge as it is often not clear where the identified output might fit or what changes might result.

2. **Use human-centred design.** This is important because we are predominantly working with the humans in the system, even if we're studying the plants or animals. This is similar to the farmer-first approach but is wider to include all key stakeholders. **Design thinking** is a human-centred approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success. See **Appendix 9a (i): Design thinking** on page 172 for a more detailed explanation of design thinking.

3. **Involve end-users** (and other key stakeholders) throughout the project (ideally prior to writing a funding application). This ensures the problem is well understood and defined, and that potential solutions are appropriately tested. This also provides greater ownership of the outcomes of the project, hopefully leading to widespread adoption where appropriate.

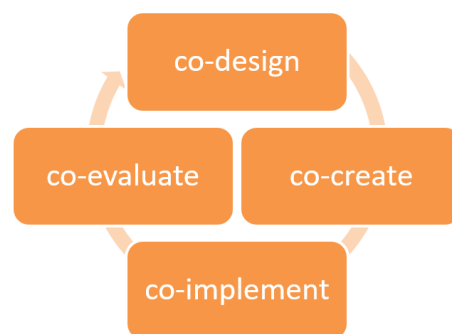


Figure 2. Collaborative project methodology.

The overall collaborative project process involves co-design, co-creation, co-implementation and co-evaluation, as shown in **Figure 2**.

When we say **co-design**, we mean engaging all the participants equally, so the researchers, extension practitioners, end-users and other key stakeholders are all empowered to make the important decisions collaboratively. You may be familiar with the IAP2 spectrum of public participation (see **Figure 3**). On the left-hand side we use mechanisms to **inform** the public, like factsheets and websites, which basically just tells them what we're going to do. When we **consult**, we use focus groups and surveys to obtain their feedback and we say we'll keep their input in mind when we make the decisions. When we **involve** them, we can use workshops, and we work with them to ensure their feedback is incorporated. When we **collaborate**, we partner with them and use more participatory approaches to seek their advice and incorporate that into the decisions. Finally, when we **empower** them, we put the decision making in their hands and we implement those decisions.

	INFORMATION LEVEL OF PUBLIC PARTICIPATION				
	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
GOAL	To provide balanced and objective information in a timely manner.	To obtain feedback on analysis, issues, alternatives and decisions.	To work with the public to make sure that concerns and aspirations are considered and understood.	To partner with the public in each aspect of the decision-making.	To place final decision-making in the hands of the public.
PROMISE	"We will keep you informed."	"We will listen to and acknowledge your concerns."	"We will work with you to ensure your concerns and aspirations are directly reflected in the decisions made."	"We will look to you for advice and innovation and incorporate this in decisions as much as possible."	"We will implement what you decide."

Figure 3. The IAP2 spectrum of public participation.

Often, we’d use a mix of these approaches in a project, but when we talk about co-design, we’re predominantly using the approaches on the right-hand side—involving, collaborating and empowering the end-users.

4. **Use an appropriate level of co-design.** While co-design is a good principle, it should be applied appropriately; so, it’s suitable for the problem being addressed. Some projects have a focus where they are extending technologies and practices that have already been developed and used elsewhere, or are required by regulation (e.g., water quality practices). In this case, it is not appropriate to go into a deep co-design activity with users. It may be that such a product easily slips into the new situation, or it may need to be modified, trialled or demonstrated. See **Appendix 9a (ii): Co-design quadrant** on page 173 for a discussion about the co-design quadrant.
5. **Design for impact.** We’re often good at planning and implementing projects, but we need to spend more time designing them for success—in this case, the adoption of R&D. To achieve this, we can use design thinking, building a theory of change, and understanding the psychological drivers for change. See **Appendix 9a (iii): Theory of change** on page 174 for a detailed explanation of how to build a theory of change.
6. **Use agile management** when appropriate, as these enable a collaborative approach, allowing end-users to provide feedback throughout the process. It increases flexibility, allowing the team to adapt more easily to change and minimise risk by failing-fast. See **Appendix 9a (iv): Agile project management** on page 177 for more details.
7. **Communicate and engage effectively.** Frequent and targeted two-way communication with key stakeholders will ensure everyone has a clear understanding of their roles and the project’s desired outcomes and impact. Use of multiple contemporary processes such as peer-to-peer learning, social network analysis, and social media will help to empower end-users to make informed decisions about adoption. The time invested in communicating and engaging helps build trust and rapport with all stakeholders, and especially end-users.

The data source for each principle is detailed in **Table 1**, where we identify and provide links to the background detail.

Table 1: Overview of data sources for each principle.

Principle	Data sources and details
Use a systems perspective	<ul style="list-style-type: none"> • Literature review: Utilise existing frameworks and understanding (page 8). • Cross RDC survey: Using a co-innovation approach (page 10). • Co-design workshop (page 150). • Pre-mortem workshops (page 163).
Use human-centred design	<ul style="list-style-type: none"> • Literature review: Utilise existing frameworks and understanding (page 8). • Cross RDC survey: Incorporating extension (page 10). • Pre-mortem workshops (page 163).
Involve end-users	<ul style="list-style-type: none"> • Literature review: Utilise existing frameworks and understanding (page 8). • Cross RDC survey: Improving stakeholder engagement (page 10). • Focus groups: End-users are hard-to-reach (page 12). • Co-design workshop (page 150). • Pre-mortem workshops (page 163).
Use an appropriate level of co-design	<ul style="list-style-type: none"> • Literature review: Collaboration across RD&E (page 8). • Focus groups: Adoption is not ideal due to the project focus (page 12). • Co-design workshop (page 150). • Pre-mortem workshops (page 163).
Design for impact	<ul style="list-style-type: none"> • Literature review: Have clear definitions for research outcomes (page 8). • Cross RDC survey: Better understanding the psychological drivers for practice change (page 10). • Focus groups: Extension is not being emphasised due to a lack of awareness or the nature of the research (page 12). • Co-design workshop (page 150). • Pre-mortem workshops (page 163).
Use agile management approaches	<ul style="list-style-type: none"> • Literature review: Some technical/ process ideas (page 8). • Review of recent projects: review of structures and processes (page 10). • Focus groups: Extension is not being prioritised due to a lack of resources, including time, budget, expertise, and trial sites (page 12). • Pre-mortem workshops (page 163).

Communicate and engage effectively	<ul style="list-style-type: none"> • Literature review: Find effective ways of communicating with farmers (page 10). • Cross RDC survey: Incorporating extension (page 10). • Focus groups: Extension not being effective due to limited skills and connections (page 12). • Co-design workshop (page 150). • Pre-mortem workshops (page 163).
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Practical steps for project teams

The following are practical steps that project teams can use to implement the principles, listed as bullet points.

Use a systems perspective. We're working in an Agricultural Innovation System where many of the elements are interconnected and where feedback loops are important.

- Use project goals to not only link to the results of a needs analysis process, but also ask for evidence that clearly demonstrates there is a problem worth solving. This may involve novel ways of collecting and presenting the data.
- Ensure that the wider system has been considered by identifying key collaborators and stakeholders, who while not directly involved in the project, can be supporters and advocates.
- Request that the project application process demonstrates that a systems perspective has been carefully considered and details how the RD&E aligns with industry priorities.

Use human-centred design. Design thinking is a human-centred approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success.

- Use the design thinking process (empathise, define, ideate, prototype and test) to better understand the real needs of the people and their practice change drivers.
- Build a theory of change based on the humans in the system and their behaviours.
- Undertake capability building of project team members in the appropriate use of human-centred design approaches may be required.

Involve end-users. Involving end-users (and other key stakeholders) throughout the project allows them to contribute ideas and creates greater ownership of the outcomes.

- Identify and engage suitable end-users (and other key stakeholders) early and throughout the life of the project.
- Explicitly engage end user to provide input into the design of outputs and/or extension process.
- Allow users to test and provide feedback at all stages of developing and finalising outputs.
- Give feedback to those who provide feedback about how their input impacted the final product.
- Keep the broader stakeholder/ end-user community informed on the design and testing process.
- Develop a specific communication and engagement plan which allows for two-way communication.
- Allow stakeholders and end-users to provide input into the plans.
- Invest in and build the capability of the end-users involved in the process.
- Facilitate collaboration and coordination with other programs/ organisations delivering in the same area/ topics to maximise synergies.
- Use good extension processes, with a mix of methods appropriate to the project and its context.
- Use peer-to-peer approaches to maximise exposure, sharing and confidence.
- Use demonstrations, on commercial farms when possible.

Use an appropriate level of co-design. The appropriate level of co-design needs to be assessed, as not all projects will require the same amount of co-design.

- Consider the dynamics of the stakeholders involved and industry politics. What may be a relatively straight-forward project sometimes ends up being complex due to the stakeholders involved.
- Clearly articulate the value proposition and understand and address the barriers.
- Trail innovative practices at a level which can be reversed if needed.
- Simply simplify packages and processes to aid in integrating into current farming systems where the innovative practice is not too complex.
- Build capacity and capability of project team members in co-design and contemporary extension approaches.

Design for impact. Spend more time designing projects for success (where success is the appropriate adoption of R&D).

- Use design thinking and involve end-users and other key stakeholders in developing a theory of change for the project, as this will guide the project priorities and activities.

- Understand the psychological drivers for change for the specific behaviours being targeted, as these vary between target audiences and are not always the same for different innovations.
- Ensure there are transparent research process with good scientific method.
- Enable specialist review of plans, processes and outputs (by specialists outside of the project team).
- Detail the method and include references in publications, not just scientific papers.
- Use real-time evaluation to capture reactions and impacts, and guide adaptive management.
- Build capability of project team members in using a theory of change.

Use agile management when appropriate. These flexible approaches enable a collaborative approach, allowing end-users to provide feedback throughout the process. It increases flexibility, allowing the team to adapt more easily to change and minimise risk by failing-fast.

- Ensure there is collaboration and coordination with other programs/ organisations delivering in the same area/ topics to maximise synergies.
- Use good extension processes with a mix of methods appropriate to the project and its context.
- Use real-time evaluation to capture reactions and impacts and guide adaptive management.
- Ensure that funders, delivery partners and project teams have a good understanding of agile management principles and processes. Capability building in contemporary project management may be required.

Communicate and engage effectively. Frequent and targeted two-way communication with key stakeholders will ensure everyone has a clear understanding of their roles and the project's desired outcomes and impact.

- Ensure that industry stakeholders are kept informed and are updated with responses to feedback provided.
- Require a specific communication and engagement plan which allows for two-way communication.
- Ensure there are good communication and extension resources spread across the target geographic area.
- Use multiple contemporary communication and engagement processes to empower end-users to make informed decisions about adoption e.g., peer-to-peer learning, social network analysis, and social media.
- Invest time in building trust and rapport with all stakeholders, and especially end-users.

Recommendations for project funders

The key recommendations for project funders as they explore how to embed these principles in practice, are as follows. While some of these may already be used in isolated RDCs, there is the potential for them to be utilised more widely.

1. **Encourage greater cross-RDC collaboration** to improve the overall system and enable greater impact. While a limited amount of cross-RDC collaboration is occurring (particularly in recent Agricultural Innovation Australia projects), it is not yet commonplace. Many farms are mixed production enterprises (e.g., grains and grazing) operating in a system. Yet most RDC funded projects are operating in silos, with negligible interaction with other projects that might well be being undertaken on the same farming enterprise, funded by other RDCs. While silos have the benefit of allowing focused specialisation, it is important that windows and doors be purposefully built into them, allowing others to easily see and explore what is happening in them. This could be achieved through work exchange programs, unconferences (where like-minded people gather to discuss and solve common problems), and more deliberate networking activities.
2. **Use programs of work** to increase internal collaboration. Within an RDC, instead of funding and managing a large number of discrete projects, the use of overarching programs of work would allow similar projects to be clustered together. This could allow the project leaders within a program to seek opportunities for collaboration and learning from each other, since their projects are inter-related. The increased communication and sharing of experiences could help build institutional knowledge and create a culture of change. This then combats the reductionist effect created by narrow-focused projects. It is likely greater adoption of innovations will occur if adoption planning is done at this program level. Additionally, more effective extension activities will be achieved when planned for at this scale as this will lend itself to offering a suite of options for improvement that suit different farming contexts.
3. **Refine funding application processes** by initiating a two-step application process would allow an initial period of engagement for new projects exploring R&D that hasn't been undertaken before, so a more detailed project plan can be co-designed with end-users over a three- to six-month period depending on the project scope. This period of co-

design would be funded after an initial Request for proposal – stage 1 (RFP-1), to allow interested project teams to collaborate and co-design approaches with end-users that meet their requirements. The subsequent Request for proposal – stage 2 (RFP-2), would then contain sufficient information about the co-designed plan to better justify the longer-term funding. More established researchers could be encouraged to partner with early-career researchers, developing their career pathway and ensuring the process isn't dominated by a few well-established individuals.

4. **Consider longer project durations** for projects involving significant end-user engagement and collaborative project methodologies. In these cases, five- and seven-year timeframes may need to be considered. These would include appropriate stop/go clauses to minimise risks. Other projects may be more suited to delivering outcomes quicker, perhaps using a fail-fast approach. A balanced portfolio would be ideal—of shorter-, medium- and longer-term durations—depending on the objectives and scope of the projects and overall program. At times, adoption-specific projects built on the accumulated knowledge of several previous RD&E projects, may work best for a particular situation.
5. **Update project documentation** (e.g., RFPs and application templates) to include suitable questions about the proposed co-design process to ensure appropriate processes and levels of collaboration are incorporated, along with monitoring and evaluation. Milestones should be compatible with an agile project management approach, with appropriate stop/go clauses to minimise risk. A checklist should be developed to guide project proposals about appropriate levels of co-design, stakeholder engagement, and monitoring and evaluation.
6. **Undertake capability building** of RDC program managers, RD&E project leaders and their teams in the areas of design thinking, collaborative project management and contemporary extension. This will help them better understand topics such as innovation systems, co-design, agile project methodologies, and stakeholder engagement.
7. **Provide adequate project resourcing** to enable inter-disciplinary teams to focus on the problem/ opportunity with sufficient time to engage and learn with end-users (and other key stakeholders). Team members should be representative and might include researchers, extension practitioners, engagement specialists, communicators, social scientists, and end-users. It is worth taking the time to get the right people with the right skills involved. Of course, the more people that are involved, the greater the time it will take to come to consensus when making decisions.
8. **Offer remuneration for end-users.** Due to the greater level of involvement, end-users should be offered appropriate remuneration for their time. This would recognise the value they provide, and that being involved in RD&E projects takes them away from their day-to-day role, which is generally their main source of income. Being able to compensate them for their time may help ensure continuity of their involvement. Of course, not everyone responds to extrinsic rewards, so it would be worth exploring the use of intrinsic rewards (such as suitable recognition and acknowledgement).

Literature review

A collection of 30 documents was reviewed, sourced from both published and grey literature. There was a wealth of information available in the literature, which captures and reflects on the experiences of attempting to increase the effectiveness of pathways to adoption and impact. Innovation in this space is broader than just applying the results of scientific research, it is also about growing, nurturing and recognising innovative capacity amongst farmers and stakeholders (Röling, 2009). See **Appendix 4: Literature review** on page 33 for the full literature review. Some key themes that emerged were:

- Collaboration across RD&E
 - Collaboration is core to success, i.e. a range of people need to be involved in the design of a model/process for this to be an effective means of changing their behaviour. Examples include farmer centred design (Eastwood et al., 2022; Liedtka, 2017)
 - Collaboration acknowledges that all involved in RD&E, from researchers to farmers are innovators too (they experiment, and trial new things). However, often they will not be able to be involved throughout the adoption pathway and so they can also hold limited views of impact (Brightling et al., 2010)
 - Recognise the experience of all involved in the RD&E process, and particularly the existing knowledge and experiences that farmers have will inform their decisions and interpretation of new information (e.g. Rose et al., 2018)

- Understanding of extension
 - Extension aims to accelerate adoption (Pannell et al., 2006)
 - Extension must be considered by all involved in RD&E as more than a one-way push of information to farmers (e.g. Douthwaite et al., 2001)
 - Farmers are diverse, and no one extension solution will work for all
 - Acknowledge the range of reasons that exist for non-adoption
 - Consider the role of private extension, and the need for effective relationships between public and private extension providers (e.g. Hunt et al., 2012; Pannell & Zilberman, 2020)
- Effective organisational leadership is critical for bringing a cultural transformation to the way an organisation can undertake its business using co-design (Bucolo et al., 2012)
- Having clear definitions
 - Have clear definitions for research outcomes. One example of this is from the cross RDC impact pathway assessment guidelines that define research outcomes as being: “Changes in practices, production or costs as a result of farm-level adoption of the outputs of the research and development process, or changes to market structures, institutions, laws and regulations”. Impacts are “The aggregated effects of adoption of the research outcomes including changes in total production, price and quality of outputs, or market efficiency, and spillover benefits and externalities”
- Utilise existing frameworks and understanding
 - Consider updating/renewing the development led innovation model developed by the dairy sector (Brightling et al., 2010) to help align the delivery activities with the intention and worldview of farmers and encourage researchers to consider more about the practical aspects of applying the new technology on farms
 - Understanding the theory of change behind interventions is critical. There are a range of tools already available that can help this discussion (e.g. Participatory Impact Pathways Analysis (PIPA), strategic roadmapping [used in the cotton industry], ADOPT, Cynefin framework)
 - A great deal is already known about drivers and influences on farmer behaviour (see Pannell et al., 2006). Farming is a socio-cultural practice so consider the goals of the farmers, their characteristics and the characteristics of the innovation, as these influence change.
 - Rose et al. (2018) provides a recent review with a number of recommendations. These are:
 - Target messages carefully
 - Fund and encourage knowledge exchange activities
 - Prove the value and ease of adoption
 - Incentivise behaviour change, including nudging
 - Encourage a research culture
 - Involve multiple actors in knowledge exchange
 - Involve friends and families in knowledge exchange activities
 - Find ways of communicating with farmers in existing networks (both formal and informal)
 - Invest in trained facilitators
 - Keep track of ongoing research on peer-to-peer learning
- Some technical/process ideas (Hort Innovation industry development portfolio review, 2021):
 - Explore contractual arrangements/agreements to ensure that reporting emphasises the project outcomes (and possible long-term impact). This involves ensuring SMART goals are clear and guidelines can fit the size of the investment
 - Develop training for project leads and Industry Development Officers/Managers on extension and project management
 - Ensure there is an emphasis on evaluation, including training/facilitation to operationalise M&E plans. Consider whether it is possible to link projects together from an evaluation perspective (e.g. several industry development projects were in their second or third project and there is an opportunity to continue the evaluation from a previous project and link this into the current project). In addition, be realistic about what is achievable in terms of practice change on-farm for a three-year project
 - Strengthen the working relationships between the extension team and delivery partners will improve the impact of levy investment.

Review of recent RD&E projects

An analysis of recent RD&E projects was undertaken to review those that have had variable success. The full report is shown in **Appendix 5: Review of recent RD&E projects** on page 75. Each participating organisation was invited to provide an example of a project that was successfully adopted and one where adoption was less optimal. While this review was a useful exercise it was often difficult to determine from project reports whether a project had been successful or not as reporting requirements currently do not often include any evaluation of project success conclusion of this process. In addition, there was considerable variation in project proposal and reporting templates across RDCs which means there are varying levels of extension details provided or needed from each project. In addition, it is not clear from some reports whether the research was demanded from the market. The various adoption pathways that were identified are captured in **Appendix 5a: Adoption pathways** on page 93.

Key themes to consider were to:

- Review the structure for final reporting. A draft template has been provided in **Appendix 5b: Proposed templates** on page 100, with headings such as achievements, outputs and outcomes for a project.
- Review the project design requirements. A draft template and criteria for project design has been provided that provides basic headings/ questions to answer. In addition, developing a checklist for project submission might also be useful (there are several RDC templates such as those used by AgriFutures)
- Explore the benefits of using a variety of reporting mechanisms (e.g., short videos summarising what has been learnt, important for the industry, or could be more useful for end-users/ levy payers) to complement traditional printed final reports.

Project categories and success factors

Two initial frameworks were created to differentiate between projects based on the focus and context rather than a single 'end-point' of adoption of direct benefits to users. These are provided in **Appendix 5c: Project categories and success factors** on page 104, where suggestions for each focus area (research, development, extension/adoption, commercialisation) are provided. This is not a continuum for an individual project, as one focus may lead to the next, for example a research project that when completed then provides an output to be commercialised. The table also highlights the factors that provide context for a project, i.e., its size, timeframe, need for co-design, complexity and (obvious) value proposition. The full list of these is best captured in the ADOPT program. However, ADOPT does not include factors such as project focus, time and resources available.

Some of the steps that could be undertaken to contribute towards these success indicators being achieved are outlined in that section. The research currently being undertaken in this project can test and add to these based on what these emerges during the process.

Cross-RDC online survey

A total of 241 people responded to the survey and the full report is shown in **Appendix 6: Cross-RDC online survey** on page 110. When asked to select the three main factors that help RD&E projects to be widely adopted by industry, almost two-thirds (63%) of the respondents selected 'There are clear benefits (production, profitability, environmental and/or social)' as the reason that RD&E projects have been widely adopted by industry. Just over half (54%) selected 'High level of extension engagement and two-way communication with end-users throughout the project', while just under half (47%) selected 'Industry representatives engaged throughout project' and 'The change is relatively easy, fits easily into current farming systems, and has a clear value proposition with quick benefits'.

When asked to select the three main reasons for less-than-optimal adoption of research results, just over half (52%) of the respondents selected 'Perceived low value proposition for end-users to change their practices' as the reason for less-than-optimal adoption. This was closely followed by 'Changes required of end-users is too complex and not easily trialled' (49%) and 'Insufficient involvement of end-users during the project' (45%).

When asked 'What's the one thing that RDCs could do differently to ensure better outcomes for their RD&E projects?', the following five key themes emerged from the data.

1. Extending the length of projects (n=36)
Many people suggested extending the funding period to five years, so that there is sufficient time to perform both

the research and the extension. As stated by one respondent, 'Adopt 5-year research agendas, 2-3 year trial programs are too short to obtain robust results that can be extended. This would allow for better integration of research and extension so messaging is delivered to growers with more rigour in the research.' The comment was made that if researchers are forced to keep trimming their project budgets, then the outcomes will be sub-optimal. It was also suggested that greater funding would allow greater interdisciplinary work and more extension and engagement activity.

2. Incorporating extension (n=30)

The concept of incorporating extension expertise into RD&E projects from the design phase was also suggested by many respondents. It was stated that it should not be a token gesture, but as one respondent put it 'Ensure every research project has a bona fide extension component (not just ad-hoc communication, e.g. a magazine article, or one-off 10 minute presentation at an industry forum). There is industry engagement at multiple stages throughout the project and a clear strategy to support industry practice change.'

As another respondent stated, 'Include D & E in research projects. Not just words, but actually investing in extension specialists to work with the researchers. Researchers are, for the most part, not social scientists. We can talk with industry, but do not have the time or interest to be all over the key methodology most appropriate to achieve adoption and demonstrate impact/evaluate. I'm not suggesting an extension specialist on every R&D project, but regionally based extension specialists that would work with multiple projects providing this expertise where and when it is required.'

To ensure this happens, another respondent suggested 'Include extension activities as milestones and demonstrate budget allocation to extension activities.' It is acknowledged this will be costly, and as stated by this respondent, 'Stop trying to make quick and cheap adoption solutions from research outcomes. The best adoption processes are created by involvement of the extension staff in the research so they have ownership and then adequately resourcing their extension work.'

3. Improving stakeholder engagement (n=21)

Engagement is not only important towards the end of the project, but throughout its lifecycle. As one respondent stated 'Engage end-users throughout the entire research project to ensure research has end-user benefit/practicalities considered.' Another commented similarly, saying 'Don't just tack end-user engagement and 'extension' on at the end as integrating end-users early not only builds potential delivery capacity but their input helps to generate more beneficial innovations for end-users - and that's the most fundamental requirement for adoption.' Another said 'Engage with industry throughout the entire process. From concept through to design and trialling.'

4. Using a co-innovation* approach (n=13) *Co-innovation involves key stakeholders (including end-users) from the very beginning of the project when they help better define the problem/opportunity. They then contribute to designing the project and helping create solutions in collaboration with the other project members.

Involving end-users and other stakeholders throughout the project life was highly recommended, and as one respondent said 'Make sure that all stakeholders are engaged in the process, right from establishing research priorities and planning for projects, right through to extension and adoption. The broader the input, the better the results will be.' Another stated that 'The most adopted programmes are those that built relationships with end-users prior to any research starting.' Involving end-users in problem identification was mentioned by this respondent who suggested 'Contract projects that engage with the end-user to identify the problem and work collaboratively towards a solution. This may require different ways of operating for the RDC, as suggested in this response 'Change procurement processes to enable more effective co-design of projects. e.g. have EOI then select 1-2 that have time and guidance to co-design projects involving all collaborators, end-users, other stakeholders (e.g. supply chain, extension deliverers) and funders.'

5. Better understanding the psychological drivers for practice change (n=11)

Better understanding the existing system and the psychological drivers of change will enable greater practice change. As one respondent commented 'Do more high-level adoption studies to understand the drivers of the decision making. For example, CRDC recently funded a study to understand the key drivers of N decision making to help inform future research.' Another said 'Involve social scientists in each project to make sure the barriers to adoption by end-users are better understood and addressed.' This should be done at the beginning of the process, as

mentioned in this comment ‘Understand the true needs of the end-users before commissioning RD&E projects and ensure end-users and people with extension/adoption expertise are involved from the outset rather than part way or at the end.’

The information gleaned from the cross-RDC survey was then used to inform the focus groups, where the emergent themes were able to be explored in more detail.

Focus groups

A series of six online focus groups were conducted with 30 participants to explore the ideas generated in the survey, as shown in **Figure 4**. The full report is presented in **Appendix 7: Focus groups** on page 140.

The high engagement with the survey was attributed to the topic of integrating extension into research as being a current hot topic across the industries. Many are highly aware of the challenge of not being able to effectively translate research findings into on-the-ground actions. Many of the researchers (who made up almost half of the respondents) want their work to make a difference. The focus groups acknowledged that the expectations of RDCs have gradually shifted to incorporate adoption, but generally the system remains the same and the support required for greater adoption is often not available. System-level changes have been advocated (e.g., best practices, project design, collaborations between RDCs) to address the issues around extension and adoption.

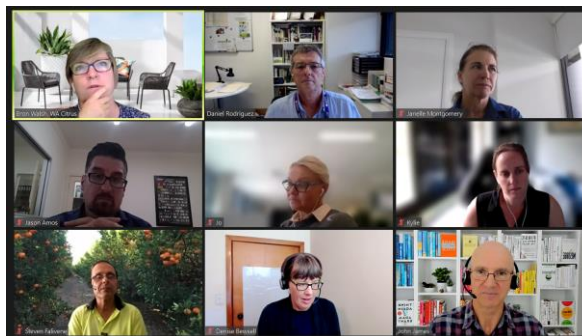


Figure 4. Some of the participants at a focus group.

Key issues that emerged when identifying the difficulties in achieving effective extension and adoption are:

- Extension is not being emphasised due to a lack of awareness or the nature of the research. Although the awareness has been increasing due to the changing expectations of RDCs, and a lot of effort has been put into the space, some projects still do not have an extension component.
- Extension is not being prioritised due to a lack of resources, including time, budget, expertise, and trial sites. When resources are limited, research output tends to be the priority instead of extension. Adoption and implementation on-farm often takes a long time, which may exceed the timeframe of the project. A three-year project may only result in developing the product or awareness change. Budget constraints limit the ability to find the right expertise that the project needs (e.g., extension specialists, economists, social scientists) as well as the trial sites (ideally multiple farms spread out across regions beyond the research site).
- Adoption is not ideal due to the project focus. Projects funded may fulfil the need identified by the industry, but not the actual end-users. Funding also tends to focus on specific aspects of the industry.
- Extension not being effective due to limited skills and connections. Researchers tend to have limited connections and access to end-users. Some researchers only want to focus on the research, and some may want to do extension but lack the proper skills.
- End-users are hard-to-reach, and the coverage is limited. The proportion of end-users that can be engaged is limited due to their time constraints, a lack of interest, and not being aware of the research. This results in the fact that it is always the same group of farmers and growers being stretched and involved in different projects, and they may already have been converted.

Potential solutions that emerged from the discussion targeting the key issues include:

Key issue 1: Extension is not being emphasised due to a lack of awareness or the nature of the research.

- Build the requirements into the proposal phase. One solution that emerged to ensure there is an extension component in the research project is to require the project leaders to consider it and engage with the industry right from the beginning when putting together the proposal. Proposals could also serve as a step to segment the research based on their adaptability (e.g., pure research vs applied).
- Manage expectations depending on timing and research type. Understand the fact that some projects are pure

research focused and may not be able to generate on-farm impact quickly. In some cases, the time the research finishes is not the time its results are most needed.

- Build a specialised extension team or bring in commercial partners. Another option mentioned by the focus groups is to have outside extension support for all research projects. It could be an internal extension team in the RDC, a project officer overseeing extension, or contracted to commercial partners. It needs to be noted that there is a risk of sending out mixed messages if the person is not dedicated to the research. IP issues may also occur when involving external companies.

Key issue 2: Extension is not being prioritised due to a lack of resources (including time, budget, expertise, and trial sites).

- Co-fund projects with a bigger impact between RDCs and private sectors. RDCs should consider cross-sectoral opportunities and collaborate to support larger projects that have an impact on system-level transformation. This means the project will have more resources and a higher chance of getting into the proper extension phase, thus a larger scale of impact. RDCs need to communicate better strategically and identify and nurture those crossovers. Involving private sectors that are not used to investing in R&DE is also worth considering.
- Extend the length of the project. RDCs should be willing to scale up projects or extend the research timeframe to enable greater time for adoption.

Key issue 3: Adoption is not ideal due to the project focus.

- Look back and learn from the past to make sure the project has the right focus. Changes occur when the pain of staying the same is greater than changing. The degree of adoption will depend on how relevant the project is to the end-users. Projects should review what has been done, what worked (both the research topic and its extension component) and what did not to ensure the project focus hits the mark and prevent duplication. A proper evaluation of a project's impact (e.g., 2-3 years after it finishes) will also help inform future projects.
- Understand the real needs on the ground. Research (e.g., ex-ante analysis) looking into what end-users are really looking for is critical to ensure the research funded has real value. RDCs need to have greater insight into this, so they have a better understanding of where to invest.
- Receive ongoing feedback. Having some end-users on the project advisory group/ committee is an extremely useful way to get ongoing feedback. This prevents the problems that arise from only having discussions at the beginning and end of some projects, which can result in a disconnect between the proposal and the implementation of the project. Engaging end-users early also helps the project team to understand the risks in adoption and be clearer about the required outputs/outcomes.

Key issue 4: Extension not being effective due to limited skills and connections.

- Provide extension training to the team. A common theme is a lack of extension skills in the research community, but articulating the project's features, advantages, and benefits is critical. Training can be provided to researchers so that they can have the skills (e.g., using appropriate language) to communicate better with the end-users.
- Build a multi-disciplinary team. Researchers sometimes are already overwhelmed with different tasks and projects, so having people who specialise in extension and other critical skills out of the researchers' skill set in the team to help free up their time will be more realistic. Note that these people are best to be involved from the beginning of the project to maximise the impact.
- Nurture the next generation. Investing in the development and training of the next generation of researchers in the extension space is also critical in succession planning and mitigating the negative impacts of staff turnover. Internships could be built into projects, and a requirement of having an early career researcher could be added to the proposal template.

Key issue 5: End-users are hard-to-reach, and the coverage is limited.

- Build trust with end-users and use trusted sources. Engagement and adoption require end-users to trust that the information is practical and beneficial to their farm. RDCs should aim to build the trust between them and the end-users or identify "champions" (e.g., opinion leaders, trusted local independent groups, or farm consultants) to sell the messages.
- Respect their time. End-users have already busy with their jobs, and their time participating in the research should be acknowledged and reimbursed. Information targeting end-users should also be manageable, and avoid using channels they are unfamiliar with.
- Provide evidence. Providing solid evidence on the research benefits can increase buy-in compared to only providing

statements. Cost-benefit analysis is also helpful to enable end-users to be motivated in considering if the product will benefit their business.

- Provide support and training. Consider ways of better supporting farmers. Ongoing training and support should be provided to end-users after the project if the adoption needs a step-change in technology.
- Investigate barriers and enablers in adoption. Psychological or other drivers that impact the research uptake need to be well-investigated to understand why extensive extension has resulted in limited or varied impact. This also ensures that what is being researched is what end-users are interested in.
- Involve the end-users from the beginning. A recurring theme emerged from the discussions: engage end-users early and bring them along the journey. This means asking for and listening to their opinions, allowing them to get hands-on with the research, and making sure the research is focusing on their real problems.

Co-design workshop

An online co-design workshop was conducted on 25 May 2022, with 30 participants from various industries and regions across Australia, as shown in **Figure 5**. The full report can be found in **Appendix 8: Co-design workshop** on page 150. The previously identified emerging themes from the research and key questions to consider were sent to the participants to read beforehand, as shown in **Appendix 8a: Pre-reading material** on page 160. During the co-design workshop the participants discussed what they agreed with, disagreed with, and thought was missing. Comments about the quadrant model were also gathered and the participants then developed the principles and implementation steps required.

This workshop confirmed the need to undertake the current project, with various comments being made about its importance and the high level of frustration with the current system and approaches. It also validated much of the information that was generated through the focus groups, particularly engaging end-users early and using co-design approaches. It also raised a number of questions to ponder, such as referring to ‘innovation’ instead of ‘extension’ and avoiding RD&E as it perpetuates the linear top-down model.

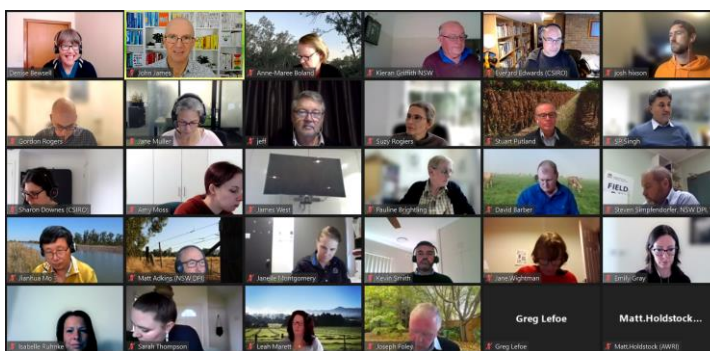


Figure 5. Some of the participants at the online co-design workshop.

It was particularly helpful having the workshop participants contribute to the development of the key principles and the subsequent implementation steps. These were then collated and synthesised into a pre-reading document that was sent to the pre-mortem workshop participants.

Pre-mortem workshops

A pre-mortem workshop for end-users was conducted on 14 June 2022 (as shown in **Figure 6**) and for the PRG on 15 June 2022, and a full report is presented in **Appendix 9: Pre-mortem workshops** on page 163. The purpose of these workshops was to help determine potential flaws in the draft principles and steps to integrate extension into RD&E projects. These were developed from the outcomes of the co-design workshop, and sent to the participants of the pre-mortem workshops to read beforehand, as shown in **Appendix 9a: Pre-reading material** on page 169.

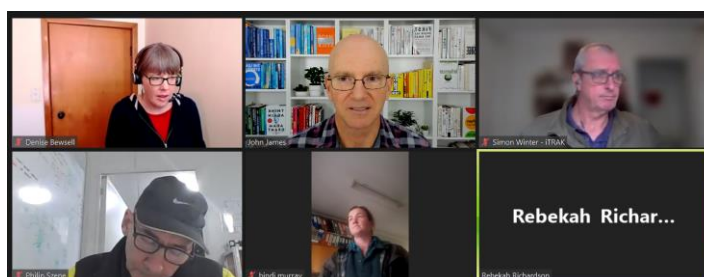


Figure 6. Participants at a pre-mortem workshop.

The end-users identified potential risks in the areas of systemic challenges, complexity, R&D resources, demonstrating value, end-user engagement, investment, blue-sky research and cost. Considerable time was then spent on developing ways to mitigate each group of potential risks. Towards the end of the workshop, a fruitful discussion occurred around whether end-users should be paid for their contribution to RD&E projects or not.

On the other hand, the PRG identified potential risks in the areas of lack of ownership, process used to create solutions, evaluation and reporting, solutions that didn’t gel, and a couple of miscellaneous items. Again, several ways to mitigate

each group of potential risks were suggested by the workshop participants.

This valuable feedback was then integrated into the final version of the principles and implementation steps to integrate extension into RD&E projects.

Outputs

Output summary

Output	Description	Detail
Stakeholder engagement plan	The plan of how key stakeholders will be engaged during the life of the project.	Completed and sent to PRG on 16/2/2022. Uploaded to Delivery Partner Portal and provided in Appendix 1: Stakeholder engagement plan (page 22).
Risk register	A detailed list of potential risks and plans for their mitigation.	Completed and sent to PRG on 16/2/2022. Uploaded to Delivery Partner Portal and provided in Appendix 2: Risk register (page 25).
Monitoring and evaluation plan	A detailed monitoring and evaluation plan, including project logic.	Completed and sent to PRG on 2/4/2022. Uploaded to Delivery Partner Portal and provided in Appendix 3: Monitoring and evaluation plan (page 29).
Project Reference Group Terms of Reference, meeting agendas and minutes	The PRG terms of reference, meeting agendas and minutes.	The terms of reference were circulated and agreed upon by the PRG. Meeting agendas and minutes were circulated to the PRG before and after each meeting.
Literature review	A collection of 30 documents was reviewed, sourced from both published and grey literature.	The literature review provided a foundation for the project, with six emergent themes informing the next steps in the project. The full document is shown in Appendix 4: Literature review (page 33).
Review of recent RD&E projects	An analysis of recent RD&E projects was undertaken to review those that have had variable success.	This review identified current practices and approaches being used by the RDCs. The full report is shown in Appendix 5: Review of recent RD&E projects (page 75).
Cross-RDC online survey	An online survey to gather thoughts and ideas from the wider RD&E community that could inform this project.	A total of 241 people responded to the survey and the full report is shown in Appendix 6: Cross-RDC online survey (page 110).
Focus groups	Online focus groups with key RD&E professionals to further explore ideas being generated in the project.	A series of six online focus groups were conducted with 30 participants to explore the ideas generated in the survey. The full report is presented in Appendix 7: Focus groups (page 140).
Co-design workshop	An online workshop enabling RD&E professionals to co-design the principles and implementation steps required to better integrate extension into RD&E projects.	A co-design workshop was conducted on Wednesday 25 May 2022, with 30 participants from across various industries and regions in Australia. The full report can be found in Appendix 8: Co-design workshop (page 150).
Pre-mortem workshop	The purpose of these workshops was to help determine potential flaws in the draft principles and steps to integrate extension	A pre-mortem workshop for end-users was conducted on 14 June 2022 and for the PRG on 15 June 2022, and a full report is presented in Appendix 9: Pre-mortem workshops (page 163).

	into RD&E projects.	
Participant evaluation	An online survey to gather data about the various participants engaged through the life of the project.	An online survey was distributed to the 197 people who were able to be identified as contributing to the project. The results are presented in Appendix 10: Participant evaluation (page 178).
Adoption and impact model/ process and guidelines, tools and resources that have been developed as part of the project	A co-designed model/ process to integrate extension into RD&E projects.	As detailed in this final report.
<p>A final report including:</p> <ul style="list-style-type: none"> • A 300 to 500 word project article suitable for media or other stakeholder use by participating RDCs • A 4-minute video for dissemination by participating RDCs • Monitoring and evaluation reporting <p>Recommendations on options to pilot the model/process, and an outline of the proposed Phase 2.</p>	As described.	Provided as part of this final report.

Outcomes

Outcome summary

Outcome	Alignment to fund outcome, strategy and KPI	Description	Evidence
Volunteers for participating in Phase 2, piloting of the model/ process	This aligns with RDC/ NSW DPI strategic plans	Phase 2 is dependent on sufficient interest and subsequent funding from RDCs. The project team sought to engage with key RD&E professionals and end-users from the co-funding organisations and beyond to drive this interest from the ground level.	A very high level of interest was expressed in this project, with 241 responses being received to the initial online survey. Over half of those respondents (132) indicated they would be willing to provide further input through interviews and focus groups. A total of 197 individuals were actively engaged through the various activities of this project as survey respondents and as participants in focus groups, co-design workshop and the pre-mortem workshops.
The knowledge, attitude, skill, aspiration, and practice (KASAP) related to applying a theory of change (impact pathway) approach to their work for the researchers and extension practitioners involved in the project.	This aligns with RDC/ NSW DPI strategic plans	The link to an online survey was sent RD&E professionals who were involved in the project to ascertain changes in their KASAP.	The knowledge of the participants in this project about the co-design process increased from 5.5 to 7.5 (on a 10-point scale where 1 is low and 10 is high). When asked how likely they would draw from the findings of this project to inform the way they might seek greater impacts from projects, an average rating of 7.2 was provided.

Monitoring and evaluation

Key Evaluation Questions

Key Evaluation Question	Project performance	Continuous improvement opportunities
To what extent has the project achieved its expected outcomes?	As a result of the co-design process, seven key principles and their implementation steps were developed. These were tested and refined through a pre-mortem process with end-users and key stakeholders.	
How relevant was the project to the needs of intended beneficiaries?	This project was highly relevant to the needs of the intended beneficiaries, as exhibited by the unusually high response rate to the online survey.	We requested key contacts in the RDCs to distribute the initial survey amongst their staff and service providers. While overall this was successful, it would appear from the results of the survey that some RDCs weren't as strongly engaged as others.
How well have intended beneficiaries been engaged in the project?	The level of engagement has exceeded expectations, with a very high level of interest in the project being expressed by many RD&E professionals. This is well demonstrated by the fact that the initial online survey received almost 250 responses when only 100 were expected. Additionally, there were no problems finding enough people to attend the focus groups or the co-design workshop.	With slightly more resources, it may have been possible to better continue the engagement with the 250 survey respondents, through webinars and email updates. Additionally, a question could have been added to the final M&E survey to ask if any respondents were specifically interested in being involved in phase 2 and if they had a project they were involved in now or thought they would be involved in in the future that would suit.
To what extent were engagement processes appropriate to the target audience/s of the project?	The use of online meetings and surveys to engage with the target audience worked very well. This removed the necessity for any travel, with its associated financial cost and time commitment. This enabled us to effectively engage with RD&E professionals across a wide geographic area.	Many of the RD&E professionals who engaged in this project are stretched for time, so it was important to not overwhelm them with too much information. Perhaps we could have asked them at the beginning how much interaction they would have liked and tailored our communications accordingly.
What efforts did the project make to improve efficiency?	Wherever possible we kept meetings as short as possible and used the flipped learning approach to maximise engagement during the meetings.	
To what extent did the project co-design process enable innovative solutions?	The co-design process enabled a high degree of innovative solutions, as evidenced by the robustness of the principles and implementation steps.	More time could have been allowed for idea generation and testing, for example by taking the devil's advocate view on some of the suggestions being made. The pre-mortem allowed for this to some extent but using de Bono's six thinking hats exercise could have helped tease out other ideas.

Recommendations for Phase 2

The following recommendations relate to how the new approach can be piloted in a Phase 2 project.

1. Nominate and **select Phase 2 participants** to pilot and test the new approaches. Ideally these will be project leaders of new RD&E projects that are yet to be funded, so the principles aren't being retrofitted into existing projects. Depending on the scope of the Phase 2 project, this may involve two or three project leaders from each co-funding organisation over a five-year period.
2. Develop and trial a **facilitated co-learning journey** for new project leaders. This will allow them to be coached to better understand and implement the new approaches in their newly funded projects. This would help new projects to be appropriately initiated and conducted. Peer-to-peer learning using heterogenous and homogenous groups from various industries would utilise action learning processes to explore and develop approaches that work in their contexts.
3. Co-design a **theory of change** for the Phase 2 project with the participating RD&E project leaders, demonstrating the technique and providing greater ownership of the project outcomes.
4. Develop a **detailed implementation guide** for project leaders and trial this. The guide would outline the steps a project leader may need to follow. This starts as a recipe to follow, but over time allows leaders to add, delete or exchange various items to fit particular contexts and requirements once they are familiar with the base recipe. This aligns with the Dreyfus model of skill acquisition where learners move through five stages: Novice, Advanced, Beginner, Competence, Proficient, and finally Expert. The guide could include a checklist to help project leaders determine appropriate levels of co-design and stakeholder engagement activities.
5. **Trial and test different templates** for project proposals and reports, to determine which ones better enable co-design processes and agile project methodologies.
6. Develop a **reflective learning process**, as part of the M&E process, to better understand the triggers and impacts of piloting new approaches. This also helps determine future tweaks to the process.
7. Design and deliver a **cross-RDC capability building program** after undertaking a **training needs analysis** of RDC program managers, project leaders and their teams to determine high priority topics. Create and trial a range of resources (short videos, fact sheets etc) accordingly, possibly in the areas of design thinking, collaborative project management and contemporary extension. This will need to be well designed as some people may overestimate their knowledge and skills in topics such as co-design, while others may underestimate them.
8. Explore processes for greater **cross-RDC collaboration**, allowing others to easily see and explore what is happening in the various silos and to allow those outside of specialist groups to see and explore what is happening in them more easily.
9. Explore **remuneration for end-users** and whether it should be offered due to their greater level of involvement. This might recognise the value they provide (by providing an extrinsic reward), or it might be a disincentive if they are gaining intrinsic rewards from their involvement.

Refereed scientific publications

No refereed scientific publications to report.

Intellectual property

No project IP or commercialisation to report.

Acknowledgements

The time and effort of the several hundred people who actively engaged with the project team during the life of this project is greatly appreciated. The project team particularly valued the way in which several participants took the time and effort to provide constructive feedback which significantly improved the quality of the final principles and implementation steps. This was co-design at its finest!

Appendix 1: Stakeholder engagement plan

Project code: HA21001 Project title: Designing the integration of extension into research projects

STEP 1 Stakeholder identification and relationship classification	STEP 2 Partnership role and contribution	STEP 3 Partnership constraints and required actions	STEP 4 Engagement strategies and frequency	STEP 5 What resources are required?	STEP 6 Responsibility for actions
A. Grower groups, associations, peak industry bodies					
Growers, producers (levy payers) who form part of industry review/prioritisation committees.	This group is critical to the success of integration of extension into research projects, so their perspective and views are important.	Very busy with day-to-day work. Short timeframe for project.	Seek input via survey, focus groups, and interviews where possible.	Distribution list.	Project lead to coordinate.
B. R&D organisations (including key personnel)					
RD&E managers from the nine co-funding organisations: 1. Hort Innovation 2. Cotton Research and Development Corporation 3. Wine Australia 4. Fisheries Research and Development Corporation 5. Dairy Australia 6. Australian Eggs 7. AgriFutures 8. LiveCorp 9. NSW Department of Primary Industries.	As co-investors, this group has a high level of commitment and interest in the project.	Short timeframe for project. Could be extra work on top of other priorities for already busy people. Those who are not members of the PRG will perhaps not be as committed or as closely involved.	PRG members: Monthly meetings online. All: initial email introducing project and seeking background documents. Then monthly emails summarising progress and seeking feedback/ suggestions. Project team to attend cross RDC extension network meeting to introduce ourselves and listen to CRDC and hopefully MLA present on their current ToC models.	PRG: 45 minute meetings using Zoom. All: email content and distribution list.	Project lead to coordinate.

RD&E practitioners from the nine co-funding organisations.	Potential survey respondents, interview participants, collaborators and co-designers.	Short timeframe for project. Could be extra work on top of other priorities for already busy people.	Initial email outlining importance of project and that their contribution could make a real difference to the future impact of RD&E projects.	Emails and phone calls as required.	Project lead to coordinate.
RD&E managers and practitioners from the seven other RDCs: 1. Australian Meat Processor Corporation 2. Australian Pork 3. Australian Wool Innovation 4. Forest and Wood Products Australia 5. Grains Research and Development Corporation 6. Meat & Livestock Australia 7. Sugar Research Australia.	While this group has chosen to not invest in this project, they are still likely to have an interest in the outcomes of the project.	Short timeframe for project. Could be extra work on top of other priorities for already busy people. Not co-investing, so perhaps not going to be too interested in the project.	Targeted emails and phone calls with RD&E practitioners and managers (especially MLA), so as to gather supplemental information as required.	To be determined.	Project lead to coordinate.
C. Independent consultants and advisers					
Contractors to the nine co-funding organisations. Other contractors not currently engaged by co-funders (potential interviewees).	Potential survey respondents or co-designers.	Short timeframe for project. Could be extra work on top of other priorities for already busy people.	Guided by PRG to be able to target important contractors/advisors.	Emails as required.	Project lead to coordinate.
D. Agribusiness input and AgTech technology suppliers and advisers					
N/A					

E. Education and training providers and key personnel					
N/A					
F. Professional business planning, financial and support services					
N/A					
G. Value chain stakeholders (wholesalers, exporters, marketing and processing)					
N/A					
H. Retailers and consumers					
N/A					
I. Government (local, Federal and State)					
Other State departments of Primary Industries (or equivalent), apart from NSW DPI.	This group is not directly involved as co-funders, but there may be some RD&E practitioners who will contribute to the survey, focus groups and interviews.	Possibly not very interested. Probably not a priority.	As part of invitation to contribute sent via project collaborators and others e.g., APEN members and Enablers of Change contacts.	No extra resources required.	Project lead to coordinate.
Others (specify)					
Drought hubs.	Potential survey respondents.	Could be extra work on top of other priorities for already busy people.	Guided by PRG to be able to target important contractors/advisors.	Emails as required.	Project lead to coordinate.
Potential co-funders for Phase 2.	Potential co-funders.	Not currently co-funding, so perhaps not going to be too interested in phase 2 of the project.	Keep list of interested parties. Update for funders and also non-funders.	Emails as required.	Project lead to coordinate.

Appendix 2: Risk register

Project risk register

The risk What could happen?	Potential risk causes/sources What could happen? What would cause it?	Potential risk impacts How would the risk impact on delivery of the project?	Risk controls What controls are in place, or will be in place, to manage the risk?	Risk likelihood with controls in place Refer to Table 2. Risk likelihood scale	Risk consequence with controls in place Refer to Table 3. Risk consequence scale	Treated risk assessment Refer to Table 4. Risk assessment matrix	Risk evaluation Could you defend this level of risk is acceptable? Yes/No	Person responsible Who is the person/s responsible for monitoring and managing the risk?
Loss of key project personnel	Resignation or retirement	Loss of key knowledge and experience	Project team are from 3 separate organisations and trained in multiple skills; Regular project team meetings to share information on progress; Central storage of project data/information	Unlikely	Insignificant	Low	Yes	Project leader
Unable to run physical events due to COVID-19 restrictions	Cancellation of physical events due to COVID-19 travel restrictions	Unable to gather data from the two physical focus groups	Swap to online meeting using Zoom or similar	Unlikely	Insignificant	Low	Yes	Project leader
Participants catching COVID-19 and not being able to attend activities	The Omicron variant is becoming widespread and another strain could also develop	Fewer people participating than planned, so less data is collected than hoped	Invite an extra 10% than the required attendees, so sufficient data can be collected	Possible	Insignificant	Low	Yes	Project leader
Low engagement in planned activities	Project participants unable or unwilling to attend activities; Activity content not relevant; Inappropriate engagement strategies for the target audience	Reduced amount of data collected. Underachievement of intended project outcomes	Development of stakeholder engagement plan; Early establishment of contacts; Close liaison with PRG	Possible	Insignificant	Low	Yes	Project leader

Minimal response to online survey	Many RD&E practitioners are feeling overwhelmed and time poor, so may not complete the online survey	Reduced amount of data collected	Consider wider distribution of survey e.g., APEN members and Enablers of Change subscribers	Possible	Insignificant	Low	Yes	Project leader
Low interest in participants volunteering for phase 2	Many RD&E practitioners are feeling overwhelmed and time poor, and may not see their continued participation in phase 2 as a priority	Reduced amount of data collected and lack of momentum for phase 2	Promote the potential benefits for participants and keep them well engaged during phase 1	Possible	Insignificant	Low	Yes	Project leader
Online meeting technical failure	Loss of internet connection; Zoom crashes; computer crashes	Loss of professionalism; disrupted meeting needing to be postponed	Project team all skilled and able to host a Zoom meeting; allocate co-hosts at beginning of meetings	Unlikely	Insignificant	Low	Yes	Project leader

Risk likelihood scale

Descriptor	Definition
Remote	May occur only in exceptional circumstances during the project; < 10% probability
Unlikely	Could occur in some circumstances during the project; 11-20% probability
Possible	Should occur at some time during the project; 21- 50% probability
Likely	Will probably occur in most circumstances during the project; 51-80% probability
Almost certain	Expected to occur in most circumstances during the project; > 80% probability

Risk consequence scale

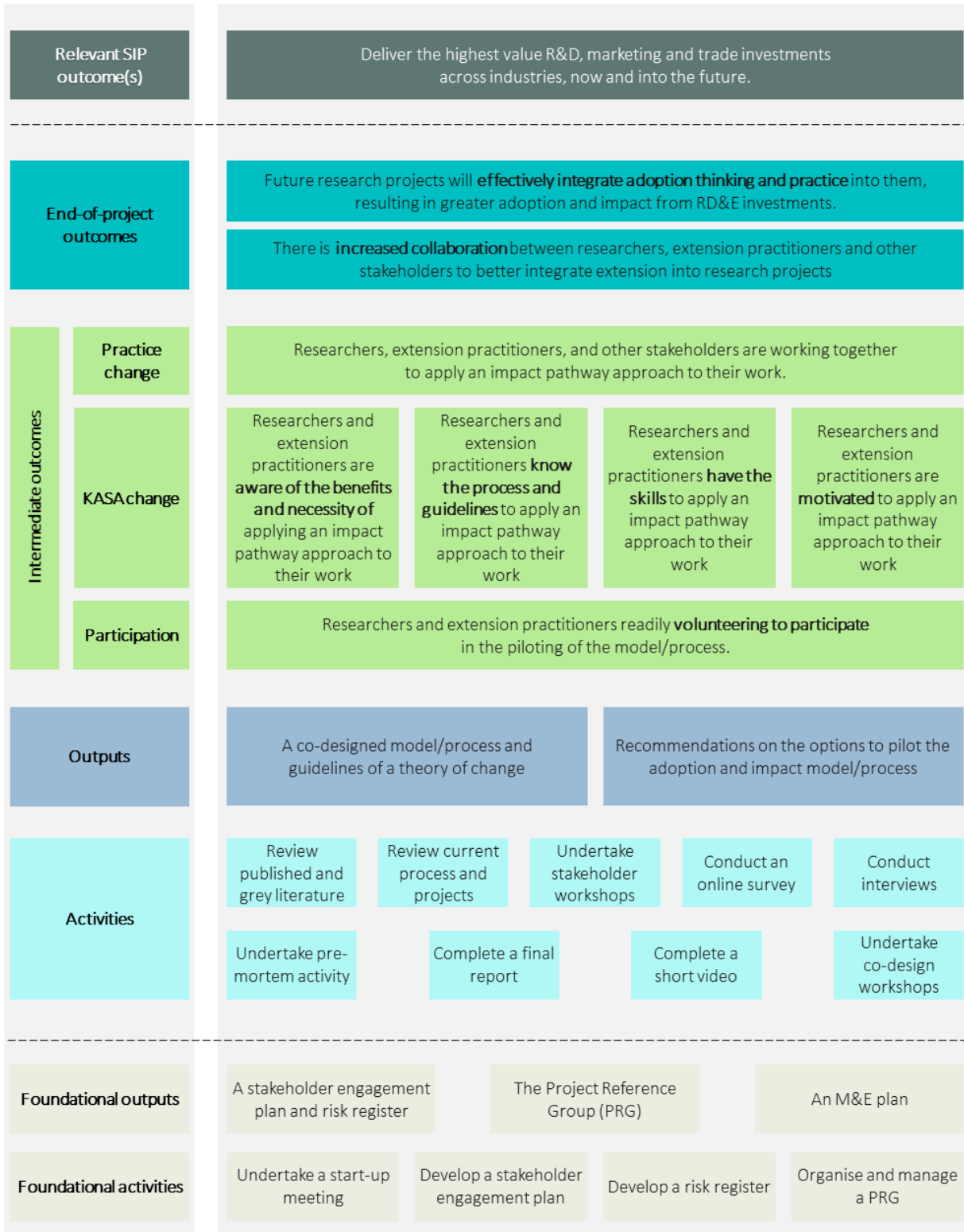
Descriptor	Definition
Insignificant	All project outputs delivered, and outcomes achieved; No loss of reputation of organisation/s; No loss of work time (e.g. due to availability of staff or weather interruptions); Minimal loss/damage to assets; Loss or impairment of a small amount of non-critical information
Minor	Outputs delivered but some quality reduction; Some reputational damage to organisation/s; Temporary loss of work time; Temporary corruption/loss of services/resources or non-critical information; Some loss of opportunity
Moderate	Failure to deliver some non-key outputs and/or some quality reduction in some non-key outputs; Moderate reputational damage to organisation/s; Medium-term loss of work time; Corruption/loss of non-critical information; Moderate loss of opportunity
Major	Failure to deliver most outputs or most key outputs; Significant reputational damage to organisation/s; Long-term loss of work time; Loss/irrecoverable corruption of critical information resources; Major loss of opportunity
Catastrophic	Outcomes unable to be achieved and failure of delivery of all outputs; Irreparable damage to reputation of organisation/s; Loss of irreplaceable key staff or work time completely disrupted; Total loss/corruption of all information services/resources; Total loss of opportunity

Risk assessment matrix

		Consequence				
Likelihood	Scale	Insignificant	Minor	Moderate	Major	Catastrophic
	Remote	Low	Low	Low	Medium	Medium
	Unlikely	Low	Low	Medium	Medium	High
	Possible	Low	Medium	Medium	High	Extreme
	Likely	Low	Medium	High	High	Extreme
	Almost Certain	Low	Medium	High	Extreme	Extreme

Appendix 3: Monitoring and evaluation plan

Program logic



Project M&E scope

Project key evaluation questions

Key evaluation questions	Project-specific questions
Effectiveness	
1. <i>To what extent has the project achieved its expected outcomes?</i>	To what extent has the project resulted in researchers and extension practitioners readily volunteering to participate in piloting of the model/process?
Relevance	
2. <i>How relevant was the project to the needs of intended beneficiaries?</i>	To what extent has the project increased the ability of research, extension practitioners and other stakeholders' ability to work together?
Process appropriateness	
3. <i>How well have intended beneficiaries been engaged in the project?</i>	To what extent were researchers and extension practitioners (and growers) involved in the design of the model/process?
4. <i>To what extent were engagement processes appropriate to the target audience/s of the project?</i>	How well did the process undertaken (survey, focus groups, interviews, co-design) engage researchers and extension practitioners in the project?
Efficiency	
5. <i>What efforts did the project make to improve efficiency?</i>	To what extent did the project use current knowledge and experience to inform co-design of the model/process?
Innovation	
6. <i>To what extent did the project co-design process enable innovative solutions?</i>	To what extent did the project process enable innovative solutions through the co-design process?

Performance expectations, data collection and analysis

Project monitoring plan

Logic level	What to monitor	Performance expectation (KPIs) and/or monitoring questions	Data collection – method (e.g. survey) and source (e.g. growers)	Timing of, and responsibility for, data collection
<i>Foundational activities</i>	Management of the Project Reference Group (PRG)	Monthly PRG updates	Record keeping	Monthly (Project leader)
<i>Activities and outputs</i>	Findings from the literature review, review of current processes and projects and initial survey	Literature review completed Review of current processes and project completed Survey completed with over 100 responses	Reports from each (Project team)	Monthly (Project leader)
	Findings from the workshops, interviews and co-design workshops	Workshops completed Interviews completed Co-design workshops completed	Reports from each (Project team)	Monthly (Project leader)
<i>Intermediate outcomes</i>	Volunteers for participating in Phase 2, piloting of the model/process	Number of researchers (and others as appropriate)	Record keeping (Project team)	On-going over project life (Project leader)
	The knowledge, attitude, skill, aspiration, and practice (KASAP) related to applying a theory of change (impact pathway) approach to their work for the researchers and extension practitioners involved in the project	KASAP levels - both before and after (retrospectively) where appropriate	Survey sent to researchers and extension practitioners involved in the project	Towards the end of the project (Project leader)
<i>End-of-project outcomes</i>	A practical and useful model/process is developed for Phase 2	Report outlining model/process	Final report (Project team)	At the end of the project (Project manager)

Reporting, learning and continuous improvement

- Stakeholder engagement plan and risk register
- A project logic and monitoring and evaluation plan with linkage to Hort Innovation Strategy (2019-2023) KPI's
- Project Reference Group Terms of Reference, meeting agendas and minutes
- Adoption and impact model/process and guidelines, tools and resources that have been developed as part of the project
- A final report including:
 - A 300 to 500 word project article suitable for media or other stakeholder use by participating RDCs
 - A 4-minute video for dissemination by participating RDCs
 - Monitoring and evaluation reporting
 - Recommendations on options to pilot the model/process, and an outline of the proposed Phase 2.

Appendix 4: Literature review

Objectives

The objectives of this project are to ensure that:

- Researchers and extension practitioners who are involved in the project increase their knowledge, attitude, skill, aspiration and practice (KASAP) in applying an impact pathway approach to their work.
- Researchers and extension officers are actively engaged in the design of a theory of change that will best inform the pathways to adoption and impact.
- A practical co-designed model/process and guidelines of a theory of change is developed. This model will be ready to pilot with researchers and extension practitioners for levy funded projects (Phase 2).

The project methodology includes a literature review of both published and grey literature to better understand current approaches to influencing greater change via RD&E, including impact pathways, co-innovation and co-design. This document provides an overview of the themes found in that literature, along with a brief overview of each piece of literature. This will be added to the review of current Research and Development Corporation (RDC) approaches identifying what is already working well alongside an analysis of recent RD&E projects that have had variable success.

Emerging themes from the literature

There was a wealth of information available in the literature, which captures and reflects on the experiences of attempting to increase the effectiveness of pathways to adoption and impact. Innovation in this space is broader than just applying the results of scientific research, it is also about growing, nurturing and recognising innovative capacity amongst farmers and stakeholders (Röling, 2009). Some key themes that emerged were:

- Collaboration across RD&E
 - Collaboration is core to success, i.e. a range of people need to be involved in the design of a model/process for this to be an effective means of changing their behaviour. Examples include farmer centred design (Eastwood et al., 2022; Liedtka, 2017)
 - Collaboration acknowledges that all involved in RD&E, from researchers to farmers are innovators too (they experiment, and trial new things). However, often they will not be able to be involved throughout the adoption pathway and so they can also hold limited views of impact (Brightling et al., 2010)
 - Recognise the experience of all involved in the RD&E process, and particularly the existing knowledge and experiences that farmers have will inform their decisions and interpretation of new information (e.g. Rose et al., 2018)
- Understanding of extension
 - Extension aims to accelerate adoption (Pannell et al., 2006)
 - Extension must be considered by all involved in RD&E as more than a one-way push of information to farmers (e.g. Douthwaite et al., 2001)
 - Farmers are diverse, and no one extension solution will work for all (Vanclay, 2004)
 - Acknowledge the range of reasons that exist for non-adoption
 - Consider the role of private extension, and the need for effective relationships between public and private extension providers (e.g. Hunt et al., 2012; Pannell & Zilberman, 2020)
- Leadership is critical (Bucolo et al., 2012)
- Having clear definitions

- Have clear definitions for research outcomes. One example of this is from the cross RDC impact pathway assessment guidelines that define research outcomes as being: *“Changes in practices, production or costs as a result of farm-level adoption of the outputs of the research and development process, or changes to market structures, institutions, laws and regulations”*. Impacts are *“The aggregated effects of adoption of the research outcomes including changes in total production, price and quality of outputs, or market efficiency, and spillover benefits and externalities”*
- Utilise existing frameworks and understanding
 - Consider updating/renewing the development led innovation model developed by the dairy sector (Brightling et al., 2010) to help align the delivery activities with the intention and worldview of farmers and encourage researchers to consider more about the practical aspects of applying the new technology on farms
 - Understanding the theory of change behind interventions is critical. There are a range of tools already available that can help this discussion (e.g. Participatory Impact Pathways Analysis (PIPA), strategic roadmapping [used in the cotton industry], ADOPT, Cynefin framework)
 - A great deal is already known about drivers and influences on farmer behaviour (see Pannell et al., 2006). Farming is a socio-cultural practice so consider the goals of the farmers, their characteristics and the characteristics of the innovation, as these influence change.
 - Rose et al. (2018) provides a recent review with a number of recommendations. These are:
 - Target messages carefully
 - Fund and encourage knowledge exchange activities
 - Prove the value and ease of adoption
 - Incentivise behaviour change, including nudging
 - Encourage a research culture
 - Involve multiple actors in knowledge exchange
 - Involve friends and families in knowledge exchange activities
 - Find ways of communicating with farmers in existing networks (both formal and informal)
 - Invest in trained facilitators
 - Keep track of ongoing research on peer-to-peer learning.
- Some technical/process ideas (Hort Innovation industry development portfolio review, 2021):
 - Explore contractual arrangements/agreements to ensure that reporting emphasises the project outcomes (and possible long term impact). This involves ensuring SMART goals are clear and guidelines can fit the size of the investment
 - Develop training for project leads and Industry Development Officers/Managers on extension and project management
 - Ensure there is an emphasis on evaluation, including training/facilitation to operationalise M&E plans. Consider whether it is possible to link projects together from an evaluation perspective (e.g. several industry development projects were in their second or third project and there is an opportunity to continue the evaluation from a previous project and link this into the current project). In addition, be realistic about what is achievable in terms of practice change on-farm for a three-year project
 - Strengthen the working relationships between the extension team and delivery partners will improve the impact of levy investment.

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1. Participatory Impact Pathways Analysis: a practical method for project planning and evaluation.	
Reference	Alvarez, S., Douthwaite, B., Thiele, G., Mackay, R., Córdoba, D., & Tehelen, K. (2010). Participatory Impact Pathways Analysis: a practical method for project planning and evaluation. <i>Development in Practice</i> , 20(8), 946-958.
Abstract / summary	The Participatory Impact Pathways Analysis (PIPA) approach enables project staff and stakeholders jointly to describe the project’s theories of action, develop logic models (especially outcome logic models), and use them for project planning and evaluation. PIPA stretches participants to predict how project outcomes can lead to social, economic, and environmental impacts . The description of these hypotheses describes the project’s impact pathways.
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • A PIPA workshop usually lasts two to three days and is attended by project stakeholders, including <ul style="list-style-type: none"> – Project implementers – Next users (or clients – refers to people and organisations that will use what the project produces) – End-users (or beneficiaries – refers to people served by the next users) – Potentially important actors (refers to people and organisations that do not work directly with the project but can help to create an enabling environment for the project) • When identifying problems, the problems can be further transformed into outcomes to avoid “negativity”, meaning rephrasing the problem into an outcome statement that will be achieved after addressing the problem • After the impact pathway is designed, the participants will typically have a reflection-and-adjustment workshop once a year, with smaller meetings every six months in between • An ex-post impact assessment can be undertaken a few years after the project ends to verify the direct benefit and trace how adoptions contributed to development impacts. • An impact model based on one or more published change theories can be developed to describe the broader outcomes resulting from the project outputs but out of the project scope. • A project can achieve both medium- and longer-term impact through 1) scaling out (horizontal spread within the same stakeholder group) and 2) scaling up (a vertical institutional expansion from adopters to other groups).

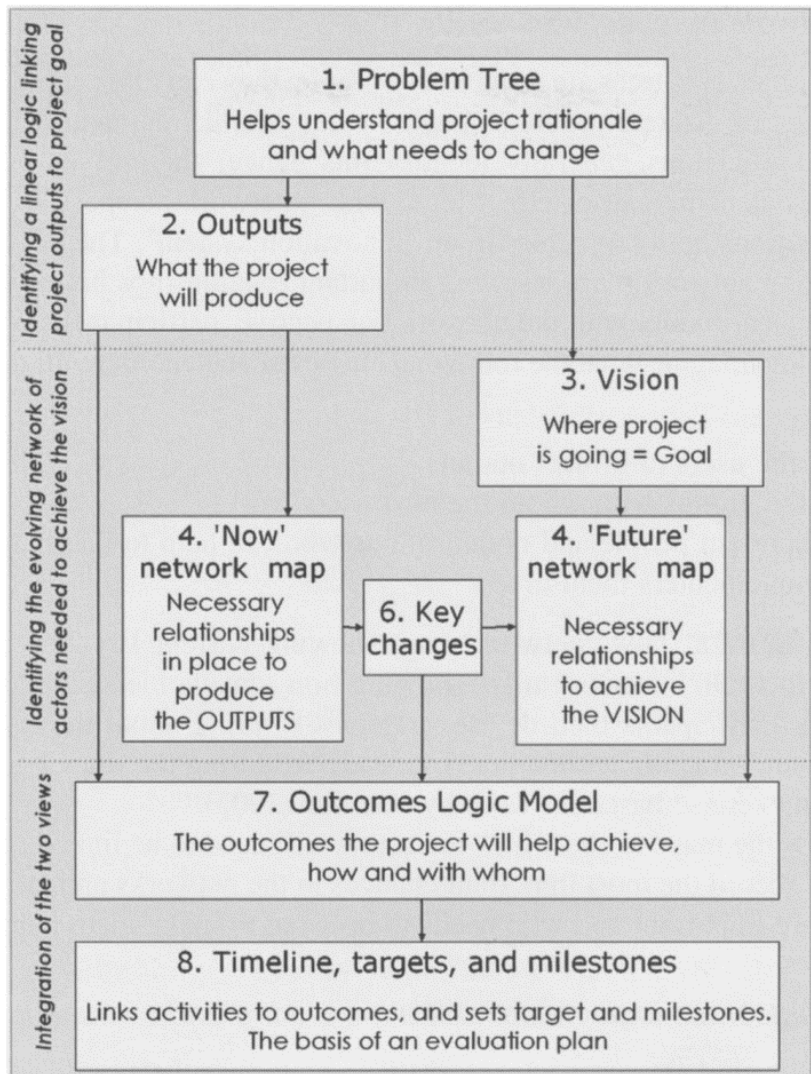
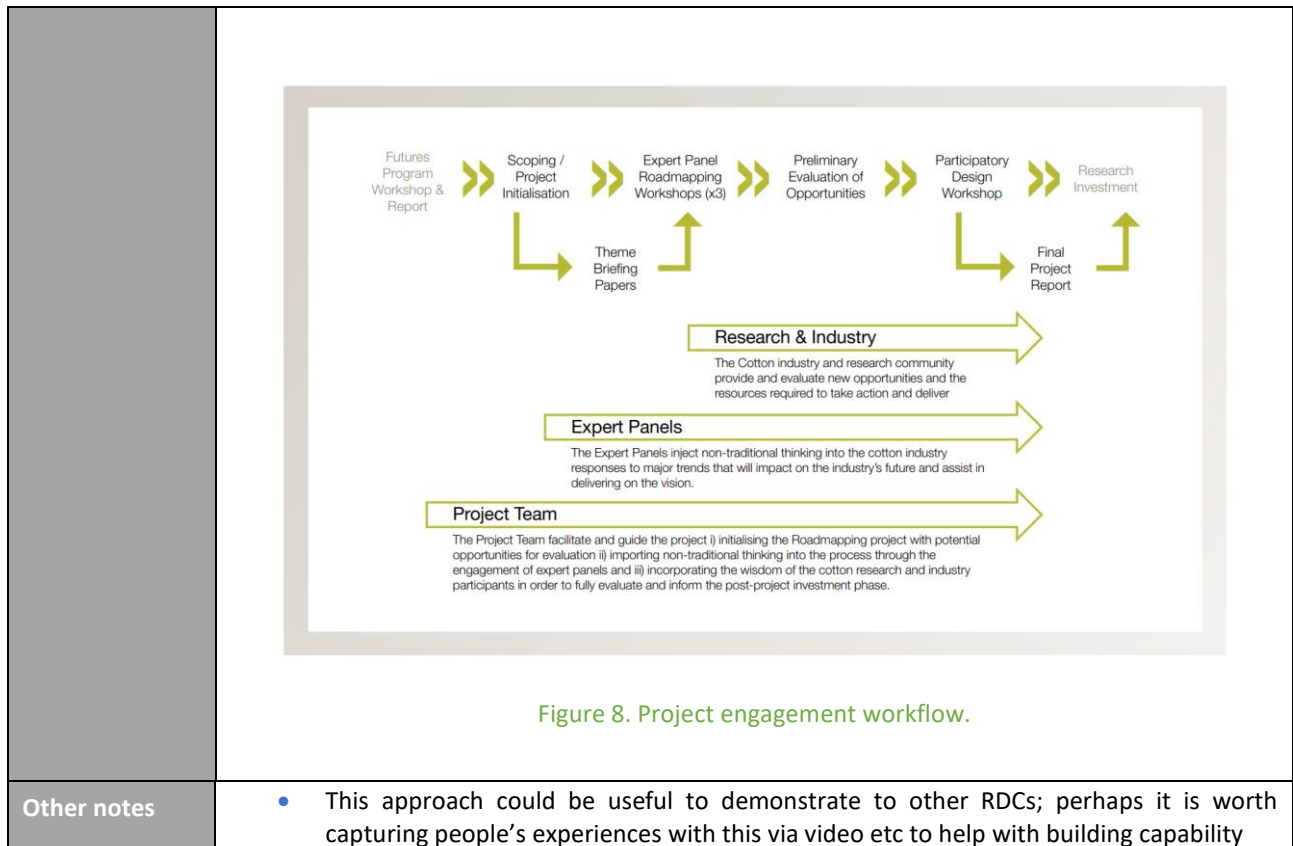


Figure 7. The PIPA workshop.

Other notes	<ul style="list-style-type: none"> This could be useful in Phase 2 of the project to help build capability and capacity for those involved in RD&E
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2. Designing a Future for Australian Cotton	
Reference	Barnett, P. (2014). Designing a Future for Australian Cotton. Report by Barnett Consulting for Cotton Research and Development Corporation, Australia.
Abstract / summary	The Strategic Roadmapping technique links and translates the major trends and drivers affecting the cotton industry in the long run to short- and medium-term opportunities, challenges and transformative investment options. The technique is best used in a complex environment to help large groups with different backgrounds and interests achieve a common understanding and allow the technical details to be placed in their proper context and, most importantly, for opportunities, barriers, and risks to become apparent. It does not include the stage of designing a project.
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • To prepare for and manage the transformation from vision to projects with investments, impact pathways need to be planned and monitored to surface the risks, barriers and opportunities along the way. • An opportunity pipeline can be used along with the planning and monitoring to reduce risk and adjust investment to ensure qualified opportunities can be harnessed and not constrained by funding. • It is also important to continue building an industry culture that's open and inclusive using the participatory approach. It <ul style="list-style-type: none"> – treats end-users (i.e., land managers) as co-creators and partners who contribute their knowledge to the research – allows researchers to get closer to the actual problems they are trying to solve and deeply understand the associated barriers, risks and opportunities. – Positions researchers as someone who use their expertise to help end-users steer research to the most impactful areas. <p>The approach has been proven to be able to reduce the occurrence of inappropriate recommendations that are directly coming from the experts to the farm.</p>
Other notes	<p>The process (shown in Figure 8) of using The Strategic Roadmapping includes:</p> <ol style="list-style-type: none"> 1. Identify key disciplines that would be important to engage in each of the theme-based expert panel roadmapping workshops (<i>there are three theme-based panels in this case</i>) 2. Generate participant lists for each discipline by identifying expertise from both within and outside the industry. It is expected that these experts generally will only have basic knowledge of the cotton industry 3. Conduct the workshops following an adapted Strategic Roadmapping technique, including <ol style="list-style-type: none"> a. agreeing on vision b. mapping the key future trends and issues c. understanding the current industry capabilities, institutions and technology, and then mapping opportunities, their impacts, required partners and priorities in order to achieve the vision. 4. Host a fourth workshop with industry leaders from research to value chain to investigate the opportunities that arose from the three theme-based workshops. Analyse and identify additional opportunities, rank opportunities by feasibility and impact, and plan for implementation of selected opportunities (transform into potential projects and investment)



Other notes

- This approach could be useful to demonstrate to other RDCs; perhaps it is worth capturing people’s experiences with this via video etc to help with building capability

3. Development-led innovation: A new model for operationalising RD&E

Reference
Brightling, P., Nettle, R., & Hope, A. (2010). Development-led innovation: A new model for operationalising RD&E. Report to Dairy Australia on project HP13550, Dairy Australia, Melbourne, Australia.

Abstract / summary
The dairy industry tends to use the traditional RD&E approaches that are moving directly from “R” to “E” and bypassing the development phase, which may cause risks such as failing to properly define the issue in a commercial environment and take practical components (knowledge and value) into consideration. Technology developed may not be able to apply across the system, and the route to change is not established to support farmers and advisors.

The development-led innovation model (refer to Figure 9) presented in the report aims to co-develop new technologies through creating stronger linkages with farmers.

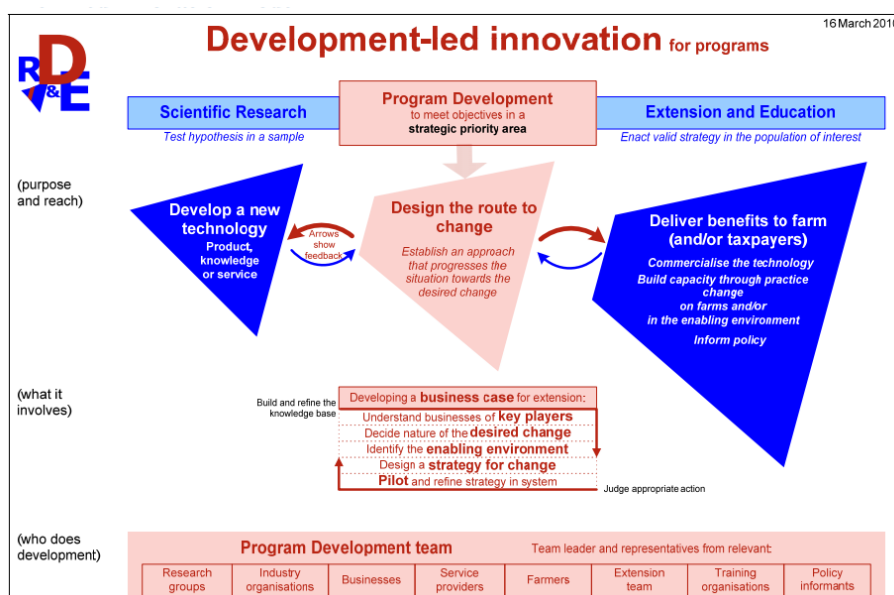


Figure 9. The D-led innovation model.

This approach deliberately includes the development phase for projects, linking directly with extension.

Key points relevant to the designing the integration of extension into research projects work

- Program development helps **align the delivery activities with the intention and worldview of farmers** and **encourages researchers to consider more about the practical aspects** of applying the new technology on farms.
- Establish an effective program development team consisting of personnel from all relevant stakeholder groups (e.g., industry bodies, businesses interested in the technology, research groups, service providers, the extension team, farmers) to provide a formal forum of interaction and enable collective action between organisations.
- The team members need to possess a high-level interest and can act on behalf of their organisations.
- The ideal program development leader should be a recognised authority with the capacity to analyse the situation and undertake management.
- Locate program activities on the RD&E spectrum to ensure they contribute to the collective effort
- Develop a business case for education and extension activities. This involves
 - growing a knowledge-base of the domain to provide appropriate and rich ideas

	<ul style="list-style-type: none"> - deciding the desired change so that stakeholders to communicate back to end-users - studying the enabling environment in terms of what is needed - designing a route of change that aims for simplicity in implementation - piloting the design in the real world and refining the approach.
<p>Other notes</p>	<ul style="list-style-type: none"> • The reason for omitting program development may include a lack of understanding of its concept, a lack of a clear process of exciting it, and a lack of resourcing and capacity. Moreover, program development also means it will delay the start of the widespread delivery to a certain extent. • The model consists of three key components. <ul style="list-style-type: none"> - Scientific research tests hypotheses and ensures the technology is scientifically sound and has the potential to create positive changes. - Program development designs the “route of change” to transform the technology into something valuable to the end-users. - Extension and education commercialise the technology and deliver it to the end-users. The extension team also undertakes evaluation to identify knowledge gaps that will hinder the uptake of the technology and measure the extent of adoption and change in their target audiences.

4. Gaps in organizational leadership: Linking strategic and operational activities through design-led propositions	
Reference	Bucolo, S., Wrigley, C., & Matthews, J. (2012). Gaps in organizational leadership: Linking strategic and operational activities through design-led propositions. Design Management Journal 7(1): 18-28.
Abstract / summary	<p>Design-led thinking can bring value to an organisation through being able to frame situations and possibilities differently, in effect bringing a cultural transformation of the way an organisation could undertake its business. However, there are gaps in organisational leadership that ensure a design-led process is successful.</p> <p>The authors present a framework to understand the value of design in business (see Figure 10). Figure 10</p> <div style="text-align: center;"> </div> <p style="text-align: center; color: #008000;">Figure 10. Design-led innovation framework.</p> <p>The authors use this framework to highlight keys roles required within an organisation to be able to effectively use a design-led approach. These are:</p> <ul style="list-style-type: none"> • Design leader: advocating for the approach • Design interpreter: someone who influences and draws together approaches across the organisation • Transitional developers: translators who convert design-led ideas into business language. <p>They conclude by outlining three leadership capabilities required:</p> <ul style="list-style-type: none"> • Maximising design-thinking learning styles of the team • Aligning competitive advantage to company strategy and brand values • Enhancing the productivity of the process
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Importance of leadership when thinking about change/new approaches
Other notes	

5. Humanising agricultural extension: A review	
Reference	Cook, B. R., Satizábal, P., & Curnow, J. (2021). Humanising agricultural extension: A review. <i>World Development</i> , 140, 105337. doi:https://doi.org/10.1016/j.worlddev.2020.105337
Abstract / summary	Extension techniques such as transferring technology from researchers to farmers with the hope of altering practice on farm have been criticised for their exclusion of social, cultural, and political factors. This research argues that humanised extension can better support farmers and deliver desired outcomes, and extensionists have a range of opportunities to alter and influence everyday knowledge and practices. Four extension approaches were reviewed.
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Take into the broader social, economic, and cultural context • Combine the farmers’ local knowledge and past experiences with researchers’ scientific knowledge to solve the problem together rather than relying on either party • Identify the best fit in terms of both local and national context rather than best practices universally. • Acknowledge the difference between farmers and find ways to engage marginalised groups (e.g., female farmers, farmers from other ethnic backgrounds, farmers with a lower level of knowledge) • Target raising household wealth and consider labour cost when transitioning into new technologies • Use the relations between farmers as opportunities. Provides the mechanisms to support the diffusion of practice change among farmers within the community to upskill farmers who are involved • Reconsider the validity and appropriateness of the technology itself rather than attribute failures to users • Use both quantitative and qualitative data to evaluate the impact of extension
Other notes	

6. Why promising technologies fail: the neglected role of user innovation during adoption	
Reference	Douthwaite, B., Keatinge, J. D. H., & Park, J. R. (2001). Why promising technologies fail: the neglected role of user innovation during adoption. <i>Research Policy</i> , 30(5), 819-836.
Abstract / summary	<p>The traditional linear view of RD&E being a pipeline where knowledge or innovation flows from research activities at one end to end-users at the other has been blamed for low levels of impact. Instead, a more effective approach is acknowledging the multiple sources of innovation and using participatory approaches with key stakeholders. While a top-down linear model can work with simple easy-to-deploy technologies, if either the new knowledge requirement or the system complexity is high, then participatory approaches will be more effective.</p> <p>Technologies that require key stakeholders to change little to make the technology work (i.e. easy to understand and use technologies introduced into simple farming systems) will have the fastest impact using a top-down approach. However, if either the new knowledge requirement or the system complexity is high then participatory approaches will be most effective.</p> <p>The model uses the following five phases: development, start-up, adaptation, expansion, and disappearance, as shown in Figure 11. The studies focused on the adaptation phase, as this was when the key stakeholders began to adopt the new technology.</p> <div style="text-align: center;"> </div> <p>Figure 11. Phases in the invention and innovation process.</p> <p>The effective management of invention and innovation requires a mix of both top-down and participatory approaches, no matter the complexity of the technology or system. The amount of R&D team participation in the early adoption process is dependent upon the amount of <i>key stakeholder</i> learning that will be required in implementing the new technology, and the scope for innovation after adoption. The more learning that is required, and the greater the scope for innovation, then the more the R&D team should participate in the adaptation phase.</p> <p>The early involvement of key stakeholders reduces the risk of the development of inappropriate technology and is more parsimonious, since the stakeholders have the necessary local knowledge themselves, as opposed to researchers trying to capture it through surveys. If the process is properly managed, early key stakeholder participation increases the potential sources of innovation and so increases the rate at which the fitness of the technology will increase. The R&D team should work closely with stakeholders during the early adoption process to facilitate their learning while also making innovative improvements to the technology.</p>

Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none">• “... successful technology represents a synthesis of the researcher and key stakeholder knowledge sets, and creating this synthesis requires more iteration and negotiation as complexity increases.”
Other notes	

<p>7. Learning selection: an evolutionary model for understanding, implementing and evaluating participatory technology development</p>	
Reference	<p>Douthwaite, B., Keatinge, J. D. H., & Park, J. R. (2002). Learning selection: an evolutionary model for understanding, implementing and evaluating participatory technology development. <i>Agricultural Systems</i>, 72(2), 109-131. doi:https://doi.org/10.1016/S0308-521X(01)00071-3</p>
Abstract / summary	<p>This paper develops a model of the early adoption process that takes into account modifications made by users and is based on data from attempts to introduce postharvest technologies into The Philippines and Vietnam. It is built on an analogy between technology change and Darwinian evolution. At the core of the model is the interactive experiential learning process — learning selection (LS) — that is analogous to natural selection in the living world (see Figure 12).</p> <p>Learning is central to innovation, which is why it is the basis of the learning selection model. The model is based on Kolb’s experiential learning model was chosen in particular because the two types of learning that characterise the innovation process — ‘learning by using’ and ‘learning by doing’ are both types of experiential learning.</p> <p style="text-align: center;"> Participant <i>i</i> behaving as a novelty generator and selector Participant <i>j</i> behaving as a novelty generator and selector </p>
<p>Figure 12. The learning selection algorithm, analogous to natural selection.</p> <p>In learning selection, the stakeholders engage with a new technology, individually playing the evolutionary roles of novelty generation and selection, and in their interactions create recombinations of ideas and experiences and the promulgation of beneficial novelties. The motivation of the people to engage in learning selection, and its outcomes, are influenced by the interaction between their lifeworlds and their environments. The model highlights the need for a nurturing of new technology during its early adaptation and adoption, until the point where the beneficiary stakeholders (manufacturers and users) are sufficiently numerous and have adequate knowledge to play the evolutionary roles themselves.</p> <p>A large amount of innovation took place after the release of the technology, as the scientists and engineers were not able to produce useful technologies—only prototypes that promised to be useful. The model (as shown in Figure 13) shows a successful technology beginning as a bright idea that is then developed during the development phase. Initially the R&D team are driving the process, while the farmers and manufacturers merely participate, if at all, as consultants. The</p>	

researchers develop their 'best bet' (a prototype embodiment of what they believe will benefit the key stakeholders) and take it to the field. The potential customers and manufacturers then provide constructive feedback and the R&D team modify their 'best bet'. Key stakeholders become increasingly interested in the technology to the point where one or two manufacturers and a few farmers believe that the machine makes a 'plausible promise' of being of benefit to them. During the adaption phase, key stakeholders (innovators according to Rogers' characterisation) actively engage and modify the technology to suit their real-world situation.

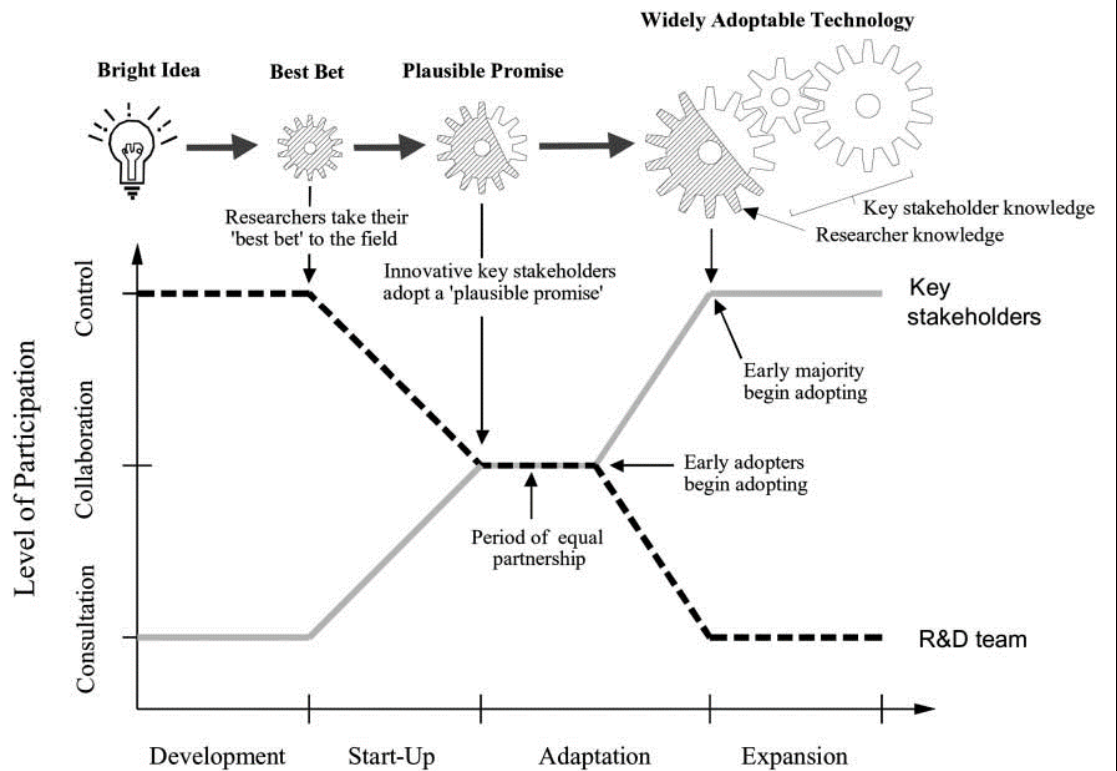


Figure 13. Phases of the invention process.

<p>Key points relevant to the designing the integration of extension into research projects work</p>	<ul style="list-style-type: none"> • Start with a plausible promise • Keep the plausible promise simple • Find a product champion • Work in a pilot site or sites where the need for the innovation is great • Work with innovative and motivated partners • Don't release the innovation too widely too soon • Know when to let go
<p>Other notes</p>	<p>It is often assumed that researchers develop new technology and farmers either adopt it or not, without significantly adapting it themselves. It is important to realise that end-users need to first adapt the new technology to local conditions prior to widespread promotion. Researchers need to be active participants in the early adoption process to nurture the development of the new technology until market selection begins to work.</p>

8. Farmer-centred design: An affordances-based framework for identifying processes that facilitate farmers as co-designers in addressing complex agricultural challenges	
Reference	Eastwood, C. R., Turner, F. J., & Romera, A. J. (2022). Farmer-centred design: An affordances-based framework for identifying processes that facilitate farmers as co-designers in addressing complex agricultural challenges. <i>Agricultural Systems</i> , 195, 103314.
Abstract / summary	<p>The agriculture redesign process is becoming increasingly aware of including end-users (i.e., farmers) into the process but struggle to treat them as equal co-designers. The farmer participatory approach implies that the problem is already being properly understood, which is often not the case as the issues farmers face are complex and have multiple dimensions. The trans-discipline research approach that involves multiple stakeholders has been proven to be challenging in managing stakeholder networks and meeting funding expectations and often focused heavily on the research side. Co-innovation relies on how researchers plan the process and roles of other stakeholders, such as farmers.</p> <p>This study discusses the implementation of the farmer-centred co-design approach, a process that focuses on understanding the farmers’ needs before designing the technology through the lens of affordance – functions provided by an object through an interaction with a user. Two case studies that employed the co-design approach were discussed.</p>
Key points relevant to the designing the integration of extension into research projects work	<p>A successful farmer-centred co-design approach should</p> <ul style="list-style-type: none"> • Allocate time to create initial engagement and form a personal relationship with farmers to understand their perspective and engage them in the project through approaches such as one-on-one interactions. • Achieve a balance between the project team pre-defining the scope of the problem and relying on farmers’ intuitive empathy during the workshop. The former tends to be more suitable for complex and system issues, while the latter is sufficient for more structured and definable problems. • Acknowledge that farmers are action-orientated practitioners. Treat farmers as knowledge providers or other more nuanced roles rather than research subjects. • Enables farmers to see the problems and solutions beyond their own worldview using approaches such as a field trip to other farms • Acknowledge that complex and opaque problems requiring specific technical specialities may be suitable for engaging farmers for only specific stages. In this case, involve farmers early in the development process and the initial design of the prototype, then engaging non-farmer figures to evolve the prototype concepts and then re-engaging farmers in the later testing phase. • Embed the tool into the process depending on the dynamic of the group and have sufficient knowledge and familiarity of the tools to provide adequate guides for farmer participants. Practitioners should be well-prepared before engaging farmers to ensure the process is clear and easy to follow
Other notes	<ul style="list-style-type: none"> • This could be useful in Phase 2 of the project and provide initial guidelines for RDCs who are relatively new to this process • There is tension in engaging with the farmer early, and then not leaving it too long to reengage with them. It would also be useful to know how often and when to engage in the development of prototypes.

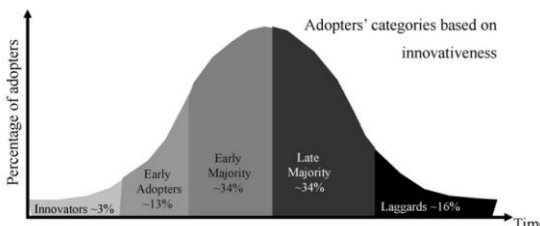
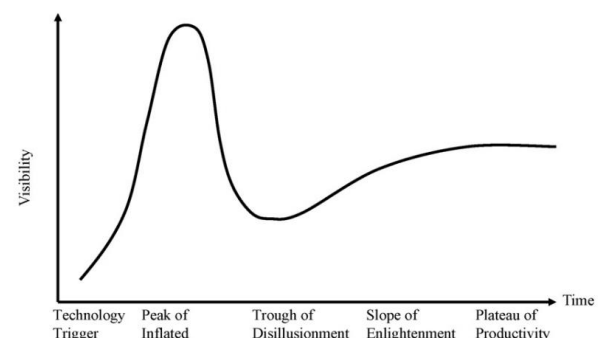
9. Agricultural Innovation — A National Approach to Grow Australia’s Future Summary report.	
Reference	Ernst & Young. (2019). Agricultural Innovation — A National Approach to Grow Australia’s Future Summary report.
Abstract / summary	<p>In September 2018, Ernst & Young was commissioned by the Australian Government Department of Agriculture and Water Resources to develop a shared vision to position the Australian agricultural innovation system for the future. Currently agricultural innovation is not designed to operate cohesively – there are lots of institutions that are in place across regions and sectors which limits effectiveness of investments. The work involved:</p> <ul style="list-style-type: none"> • Stakeholder consultation • Investigating mega trends • International research looking for insights from the international arena <p>Alongside a vision for the future, five recommendations were made:</p> <ol style="list-style-type: none"> 1. Strengthening ecosystem leadership and cohesion to build a culture of collaboration 2. Improving the balance of investment so that incremental and transformational innovation occurs 3. Establishing innovation practices (seen internationally) that allow better outcomes (e.g. commercialisation and adoption) 4. Strengthen the regions by supporting farming system groups and leaders and communities 5. Provide the infrastructure that underpins data use and sharing
Key points relevant to the designing the integration of extension into research projects work	<p>Highlights the need for:</p> <ul style="list-style-type: none"> • Researchers to be located with potential end-users and collaborators • A collaborative approach between industry and researchers • Development of a network for support as researchers change their approaches
Other notes	

10. Sugarcane Industry Futures Forum	
Reference	Henderson, T., Clement, L., & Edwards, B. (2018). Sugarcane Industry Futures Forum. Sugar Research Australia Limited.
Abstract / summary	<p>The Sugarcane Industry Futures Forum was held to bring together industry, research, government and other stakeholders to explore a vision for the Australian sugarcane industry. The forum was to be a place where discussions could occur about what the future was currently looking like and explore ideas for how the future could be different.</p> <p>As outlined in the report, the objectives of the Forum were to:</p> <ol style="list-style-type: none"> 1. Inspire and educate participants through strategic foresight. 2. Determine how to develop a vision for the sugarcane industry, with whole-of-industry leadership. 3. Identify next steps and an action plan. <p>The forum was designed around three sessions:</p> <ol style="list-style-type: none"> 1. What might the future look like? 2. Perspectives on the near term. 3. What will we do? <p>Seventy people attended the forum on 17 April 2018.</p> <p>Key messages to come out of the forum were:</p> <ul style="list-style-type: none"> • Sugar will remain a core output of the industry • Diversification is critical to future profitability and sustainability, specifically revenue streams across food, fuel, energy and fibre products • Collaboration is critical for success <p>A number of actions and opportunities were highlighted that were thought would lead to a better understanding of the industry and a vision. These were:</p> <ul style="list-style-type: none"> • Roadmap for diversification • A strategy for employment and capability • Improving collaboration • Leveraging scale.
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • An example of good practice for bringing a range of stakeholders together – the report outlines the planning involved for those who organised it and the pre-work participants were asked to do. • Emphasis on collaboration – to help bring people together to think about and engage with a vision. • An important part of the process would be to indicate program areas for RD&E investment.
Other notes	

11. Industry Development Portfolio Review Report.	
Reference	Hort Innovation. (2021). Industry Development Portfolio Review Report.
Abstract / summary	<p>A review of the Hort Innovation Industry Development Portfolio was undertaken. This portfolio has the regional extension managers who work across six regions in Australia (Northern Australia, Western Australia, North East, South East, Tristate, and Southern Australia). They work with existing extension providers, industry and potential co-investment partners to increase the impact of the research and development levy investments. The review was set up to help maximise the efficiency of the levy investment for growers.</p> <p>“Key findings:</p> <ul style="list-style-type: none"> • A high proportion of current projects were able to demonstrate “effective” or “very effective” engagement with growers and other industry stakeholders. • An increase in the knowledge and skills of growers and their intention to change was outlined. • There was a high level of reporting of all project outputs, but a lack of rigor in reporting on outcomes benefitting growers. This can partly be attributed to Hort Innovation Request for proposals (RFPs) having been broad in asking for required project objectives and outcomes. • Project management upgrades in relation to the Monitoring and Evaluation guidelines implemented by Hort Innovation in 2017 have helped Delivery Partners report on project outputs and outcomes.”
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Explore contractual arrangements/agreements to ensure that reporting emphasises the project outcomes (and possible long-term impact). This involves ensuring SMART goals are clear and guidelines can fit the size of the investment • Training is required for project leads and Industry Development Officers/Managers on extension and project management • Ensure there is an emphasis on evaluation, including training/facilitation to operationalise M&E plans. Consider whether it is possible to link projects together from an evaluation perspective (e.g. several industry development projects were in their second or third project and there is an opportunity to continue the evaluation from a previous project and link this into the current project) • Given the point above, be realistic about what is achievable in terms of practice change on-farm for a three-year project • Strengthening the working relationships between the extension team and delivery partners will improve the impact of levy investment
Other notes	

12. The many turnings of agricultural extension in Australia	
Reference	Hunt, W., Birch, C., Coutts, J., & Vanclay, F. (2012). The many turnings of agricultural extension in Australia. <i>The Journal of Agricultural Education and Extension</i> , 18(1), 9-26.
Abstract / summary	<p>In this article the development of extension as a discipline in Australia is outlined. The authors highlight the differences between the European and American experiences in extension. They classify the journey of the discipline of extension as going through four ‘turnings’:</p> <ol style="list-style-type: none"> 1. Crisis 2. High 3. Awakening 4. Unravelling. <p>The tension between the public and private sectors of extension is explored, including considering whether this is market failure. There has been a disconnection in the RD&E feedback loop which has resulted in information gaps in some regions and sectors.</p>
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Quote from Coutts (2000: 2) in the conclusion: extension is “the oil that makes things happen. It is about interaction between people, information sharing, dialogue, learning and action. Nothing is going to change on the ground, regardless of the excellence of legislation or science unless this oil is there”. • Highlights the need for partnership between the public and private sector for agricultural extension to be effective and efficient
Other notes	

13. Predicting farmer uptake of new agricultural practices: A tool for research, extension and policy.	
Reference	Kuehne, G., Llewellyn, R., Pannell, D. J., Wilkinson, R., Dolling, P., Ouzman, J., & Ewing, M. (2017). Predicting farmer uptake of new agricultural practices: A tool for research, extension and policy. <i>Agricultural Systems</i> , 156, 115-125.
Abstract / summary	The Adoption and Diffusion Outcome Prediction Tool (ADOPT) is introduced and described. “Users of ADOPT respond to 22 questions related to: a) characteristics of the practice that influence its relative advantage, b) characteristics of the population influencing their perceptions of the relative advantage of the practice, c) characteristics of the practice influencing the ease and speed of learning about it, and d) characteristics of the potential adopters that influence their ability to learn about the practice. ADOPT provides a prediction of the diffusion curve of the practice and sensitivity analyses of the factors influencing the speed and peak level of adoption.”
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • This is a useful tool for helping both those familiar with, and those less familiar with adoption theory, to understand the influences and drivers of change via extension. It could be a useful training tool • How often has ADOPT been used for project development?
Other notes	See https://www.enablersofchange.com.au/how-can-you-predict-the-rate-of-adoption/

14. Improving pathways to adoption: Putting the right P's in precision agriculture	
Reference	Lamb, D. W., Frazier, P., & Adams, P. (2008). Improving pathways to adoption: Putting the right P's in precision agriculture. <i>Computers and Electronics in Agriculture</i> , 61(1), 4-9.
Abstract / summary	<p>Precision agricultural (PA) technologies have been widely developed and proven with benefits, yet the adoption of the technology among users is not as good as expected – few PA innovations can be adopted beyond the early adopter level or the Trough of Disillusionment stage of the Hype Cycle (refer to Figure 14). The gap between developers and the end-user market exists as the focus of the two is different. For developers, the focuses are position, product, pricing, placement and promotion, whereas, for users, the focuses are preparation, protocols, performance, and perception.</p> <div style="text-align: center;">  </div> <p>Fig. 1 – Bell-curve illustrating distribution of adopter categories based on innovativeness (Adapted from Rogers, 2003).</p> <div style="text-align: center;">  </div> <p>Fig. 2 – The five key stages of the Gartner Hype Cycle (adapted from Fenn and Linden, 2005).</p> <p style="text-align: center; color: green;">Figure 14. Processes of adoption.</p> <p>Increased competition in the market has led to inadequate field-testing to safeguard the quality of the tools on the shelf. These tools are unlikely to pass the early stages of adoption and get into the mainstream market as the late adopters tend to make decisions based on information exchange with the earlier adopters.</p>
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Developers should pay as much attention to protocols and performance as possible and recognise the real applicability of the technology rather than creating false or over-optimistic expectations. Both the quality and the application of the tool need to undergo comprehensive field testing. • Developers cannot only work with innovators but also with the mainstream market (i.e., the majorities, refer to Figure 14) to avoid getting an unrealistic impression of the needs, expectations, and skills of the users. Engaging a broader cross-sectional of farmers and understanding their respective attitudes and agriculture system during development and testing phases could reduce the impediment during uptake. • Evaluation of user experience should continue through the entire adoption cycle to capture the changing expectations of users, and a commitment to continually improve the technology needs to be made by developers.
Other notes	

<p>15. From ideas to impact: A revitalised collaborative innovation model for Australian agriculture</p>	
Reference	Lamb, A., Turner, C., & Andrews, J. (2021). From ideas to impact: A revitalised collaborative innovation model for Australian agriculture (AgriFutures Australia Publication No. 21-081)
Abstract / summary	<p>AgriFutures Australia engaged Innovation Studios to develop a best practice methodology for challenge-led and open innovation for rural industries in Australia. A global scan of innovation models and insights from successful case studies, such as v2food’s plant-based burger patty, informed the suggested approach, which will help RDCs bridge the idea-to-innovation chasm. As RDCs continue to work together, there are real benefits in having a thorough understanding of the open innovation methodology to ensure the research they invest in delivers real-world results and value.</p> <p>This project’s key objective is to design a collaborative open innovation model that leverages the unique strengths of different types of organisations to take ideas through to value and impact.</p>
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> Research needs to ensure that the ideas they have can get into the user market and have the chance to succeed. Both technical readiness of the innovation (can we do it?) and investment readiness (should we do it?) ought to be tested. That means that in practice, a business model needs to be developed alongside innovation to ensure that the technology can be adopted effectively in the market <ul style="list-style-type: none"> Note that actionable information about a problem needs to be found in the real world through talking to real people rather than desktop research Developing prototypes early in the process guarantees a greater degree of certainty that the solution will solve the right problem <p style="text-align: center;"> Technology Readiness Levels + Investment Readiness Levels </p> <p style="text-align: center;"> Figure 15. Technical and investment readiness. </p> <ul style="list-style-type: none"> RDCs need to ensure that the purpose of developing the technology is not focusing on short-termism, and the cultural and behavioural impact of the program is strongly considered Sponsorship and active endorsement of the program should come from the highest possible leadership level to ensure organisational agility through the execution RDCs should focus their energy on perfecting a single framework/methodology to prevent duplications and fragmentations An open innovation methodology is developed (refer to Figure 16). It recommended that <ul style="list-style-type: none"> A steering committee is formed rather than a management committee

- The number of RDCs for a pilot is ideally two to three
- Problems could either be a new one sourced from consumer/societal trends, industry, or venture capital theses, or a **failed one using traditional methodologies**
- Market risk should be the main focus, so choose solutions with lower technical risks



Figure 16. The proposed open innovation methodology.

Other notes

There were three impediments identified in addition to the work outlined above. These were:

- Research providers typically only take an idea to the invention stage whereas industry will not engage until an invention has been de-risked (technical, scale-up and market). This creates the ‘Valley of Death’ that is difficult to work through.
- R&D projects identify and solve technical problems, but this is not enough to deliver value and impact for end-users. Technology in isolation neglects human behavioural changes required to for adoption.
- Returning value to levy payers results in a focus on short-term (mostly) production problems. It makes it difficult for the RDCs to embrace longer-term transformational projects.

16. Beyond Better Solutions: Design Thinking as a Social Technology	
Reference	Liedtka, J. (2017). Beyond Better Solutions: Design Thinking as a Social Technology. Paper presented at the Conference Proceedings of the Design Management Academy Hong Kong.
Abstract / summary	“The value delivered by design thinking is almost always seen to be improvements in the creativity and usefulness of the solutions produced. This paper takes a broader view of the potential power of design thinking, highlighting its role as a social technology for enhancing the productivity of conversations for change across difference. Examined through this lens, design thinking can be observed to aid diverse sets of stakeholders’ abilities to work together to both produce higher order, more innovative solutions and to implement them more successfully. In this way, it acts as a facilitator of the processes of collectives, by enhancing their ability to learn, align and change together. This paper draws on both the author’s extensive field research on the use of design thinking in social sector organizations, as well as on the literature of complex social systems, to discuss implications for both practitioners and scholars interested in assessing the impact of design thinking on organizational performance.”
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Design thinking is increasing in popularity and is being adopted in a range of sectors. • Complex systems are characterised by significant connectivity, and decentralised control. Therefore, the chance of finding a single solution is low in complex systems. Other characteristics include: <ul style="list-style-type: none"> • As organisations decentralise their decision making, they have the opportunity to access diverse local knowledge and experiences to come up with innovative solutions. • The creation of new knowledge involves both perspective taking and perspective making. • A fear of making mistakes or failing can often lead to inaction. • In order to create adaptive spaces that support teams to navigate uncertainty, organisations should: <ul style="list-style-type: none"> – Avoid centralised hierarchical control in favour of de-centralising decision-making – Broker information across a set of diverse local actors – Develop shared meaning and interests and collective performance norms – Manage on-going coordination of learning and performance enhancement – Create cohesive groups of diverse local actors that provide psychological safety. • Design thinking can support innovation in complex systems.
Other notes	

17. Understanding and promoting adoption of conservation practices by rural landholders	
Reference	Pannell, D., Marshall, G., Barr, N., Curtis, A., Vanclay, F., & Wilkinson, R. (2006). Understanding and promoting adoption of conservation practices by rural landholders. Australian Journal of Experimental Agriculture, 46(11), 1407-1424.
Abstract / summary	<p>The authors outline a cross-disciplinary analysis on the adoption of rural innovations highlighting that adoption depends on landholders being convinced that the innovation advances their goals and that this is greater than the costs associated with adoption. They explore adoption as a process of learning (moving from awareness to evaluation to adoption, review and continued adoption or dis-adoption). They also explore the characteristics of adopters, that is, the social, cultural and personal influences on adoption decision. Lastly, they explore the characteristics of innovation. Innovations are more likely to be adopted when they have high 'relative advantage' (are perceived to be better than the current idea or practice), and when they are readily triable (i.e. easy to test and learn about).</p> <p>They identify the main contributions of extension to be raising awareness and changing perceptions of the relevance and performance of an innovation. It is difficult and ethically contentious, to change farmer's goals. Extension's main role therefore is to accelerate the adoption process, rather than lift the final level of adoption (i.e. speed up the process of adoption for those farmer who were going to adopt the innovation anyway). Two other issues for extension are:</p> <ul style="list-style-type: none"> • Establishing legitimacy and credibility (trust is determined by the extent to which a farmer believes that an advisor understands and respects their goals). • Using multiple methods, repetition multiple deliverers and harnessing peer pressure
Key points relevant to the designing the integration of extension into research projects work	As above.
Other notes	

18. Understanding Adoption of Innovations and Behavior Change to Improve Agricultural Policy	
Reference	<i>Pannell, D., & Zilberman, D. (2020). Understanding Adoption of Innovations and Behavior Change to Improve Agricultural Policy. Applied Economic Perspectives and Policy, 42(1), 3-7. doi:https://doi.org/10.1002/aep.13013</i>
Abstract / summary	“Research on the adoption of new practices and new behaviors in agriculture continues to grow and evolve, and its relevance to policy remains high. This special issue presents 10 papers that provide overviews of important aspects of the recent adoption literature, or identify gaps and opportunities in the literature. Adoption research has been innovative in a number of ways, including its recognition of adoption decision making as a process, not an event; its emphases on heterogeneity and learning; and its strong multidisciplinary flavour. There is scope for further innovation through efforts to enhance predictions of adoption, better understanding the balance between profit and non-profit motivations, and better recognizing the influence on adoption of characteristics of the innovations, not just characteristics of the potential adopters and their contexts. Opportunities for policy include effort to support women farmers’ adoption of beneficial innovations in developing countries, and use of tools and approaches from marketing in public extension programs.”
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Adoption decision making doesn’t occur instantaneously, it is a process. • Farmers considering adopting a new technology will undertake learning to reduce their uncertainty about it. • Most adoption research is focussed on the past, there is a need for greater focus on adoption predictions (such as the ADOPT framework). <ul style="list-style-type: none"> – This would help to predict the likelihood of prediction and increase the return on extension efforts. • There is greater decentralisation of extension in a number of countries, and an increased involvement of the private sector in extension. This can lead to an increase of regionally targeted extension, but can also disadvantage resource poor groups from accessing this. • Increased levels of formal education can lead to greater rates of adoption.
Other notes	

19. Innovative design for agriculture in the move towards sustainability: scientific challenges	
Reference	Prost, L., Berthet, E., Marianne, C., Jeuffroy, M.-H., Labatut, J., & Jean-Marc, M. (2017). Innovative design for agriculture in the move towards sustainability: scientific challenges. <i>Research in Engineering Design</i> , 28. doi:10.1007/s00163-016-0233-4
Abstract / summary	“Agriculture is facing increasing innovation challenges to meet current societal expectations, yet very few design science studies are devoted to it. This paper highlights some of the particularities of the objects, reasoning and organization of design in agriculture that may open fruitful scientific dialogue between design scientists and agricultural scientists. We first provide an overview of the broad range of objects that are designed in agriculture, and point out their specific characteristics with regard to design. We then identify some particular challenges of design activities in agriculture and review how they have been addressed up to now. Finally, we discuss how design challenges and characteristics in agriculture can contribute to current debate in the field of design science. We propose two main lines of inquiry and debate: enhancing the links between design reasoning and organization, and further conceptualizing the status of use situations in design to deal with uncertainties and complexity in design processes.”
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • As the design process involves a range of actors and organisations, they must be collaborative. There is opportunity to create new forums and organisations to bring the various actors together (including farmers) to find innovative solutions. • Agricultural designers have faced challenges and identified solutions related to agricultural design. The design regime shift implies: <ul style="list-style-type: none"> – Renewing the identity of the designed objects (adopting a broadened view within the design process) – Addressing the diversity of environments (utilising design methods that allow for the variation in farms and regions) – Increasingly collective and distributed (moving away from the vertical organisation of design processes established after World War II) – Articulating heterogeneous forms of knowledge (adapting to include on-farm and scientific knowledge and experience in the design process).
Other notes	

20. Understanding how to influence farmers’ decision-making behaviour: a social science literature review	
Reference	<i>Rose, D. C., Keating, C., & Morris, C. (2018). Understanding how to influence farmers’ decision-making behaviour: a social science literature review. In: Agriculture and Horticulture Development Board.</i>
Abstract / summary	<p>“In order to make a difference on the ground, policies, innovations, and best practices, must be implemented on-farm. Researchers, policy-makers, and other organisations have long investigated why some recommendations are never adopted by farmers, and much of this work has used behavioural approaches. The common rationale for such work tends to proceed along the lines of, ‘if only we can understand farmers better, then we can influence their behaviours and ultimately convince them to adopt our recommendations’. There is now a large body of agricultural literature on behavioural change, which tends to focus on individual farmers. Limited attention has, however, been placed on consolidating the lessons learned from the plethora of studies, which is particularly concerning given that recent studies continue to identify significant barriers to behavioural change amongst farmers. This report set out to review the lessons learned from existing behavioural change work in agriculture, and supplemented the insights gained with knowledge from similar behavioural work conducted in other fields, such as health, medicine, and diet. We reviewed over 200 papers towards one clear objective – to understand how behavioural change approaches in the context of farmer decision-making could be improved, or even as we suggest, evolve.”</p>
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Key recommendations were identified in the literature reviewed for this work, including: <ul style="list-style-type: none"> – Target messages carefully – Fund and encourage knowledge exchange activities – Prove the value and ease of adoption – Incentivise behaviour change, including nudging. • The authors made a series of recommendations, including: <ul style="list-style-type: none"> – Encourage a research culture – Involve multiple actors in knowledge exchange – Involve friends and families in knowledge exchange activities – Find ways of communicating with farmers in existing networks (both formal and informal) – Invest in trained facilitators – Recruit ‘peer champions’ to shape AHDB advice and literature – Keep track of ongoing research on peer-to-peer learning – AHDB could lead a new phase of social change initiatives. • Sutherland et al. (2012) developed a framework to predict the evolution of farmer decision making: <ul style="list-style-type: none"> – Path dependency (keep doing what has always been done) – Trigger event (leads to the consideration of something new) – Active assessment (uses a range of sources to assess the options) – Implementation – Consolidation (monitors and learns from what has been tried). • Six stages were identified to enable a seamless transition from design to implementation: <ul style="list-style-type: none"> – Who is the user? – Why should they want to use it? – Can they use it?

	<ul style="list-style-type: none">- Is it easy to use?- What's the delivery plan?- What's the legacy plan?
Other notes	

21. Pathways for impact: scientists’ different perspectives on agricultural innovation	
Reference	Röling, N. (2009). Pathways for impact: scientists’ different perspectives on agricultural innovation. <i>International journal of agricultural sustainability</i> , 7(2), 83-94.
Abstract / summary	<p>“This paper takes the viewpoint of a social scientist and looks at agricultural scientists’ pathways for science impact. Awareness of these pathways is increasingly becoming part and parcel of the professionalism of the agricultural scientist, now that the pressure is on to mobilize smallholders and their productive resources for (global) food security and for reducing persistent rural poverty. Significant new thinking about pathways is emerging and it is useful to present some of this, even if it is not cut-and-dried. This new thinking focuses on innovation, not as the end-of-pipe outcome of development and transfer (or ‘delivery’) of results of research to ‘ultimate users’, but as a process of technical and institutional change at farm and higher system levels that impacts on productivity, sustainability and poverty reduction.</p> <p>This paper will review technology supply push; farmer-driven innovation; market-propelled or induced innovation based on the agricultural treadmill; participatory technology development; and innovation systems. The pathways reviewed all have their merits; the paper will assess them from the perspective of improving smallholder productivity and livelihoods.</p> <p>This paper concludes that many agricultural scientists have not developed their thinking about how the fruits of their work can help make the world a better place. This is a flaw in their professionalism. Curriculum development, training, promotion criteria, standards used in refereeing journal articles and research funding could benefit from taking on board understanding of pathways of science-for-impact.”</p>
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Innovation is broader than just applying the results of scientific research, it is also about growing, nurturing and recognising innovative capacity amongst farmers and stakeholders. • There are a range of different pathways for reaching farmers: <ul style="list-style-type: none"> – ‘Technology supply push’ has limited effectiveness of reaching farmers and promoting change – ‘Farmer driven innovation’ can be a successful approach, with some farmers experimenting different approaches on farm over multiple generations – ‘Participatory development’ can harness farmer knowledge and experience – ‘Market-propelled or induced innovation’ is the most typically used pathway – ‘Innovation systems’ is a new emerging pathway.
Other notes	

22. Cross-RDC Impact Assessment Program: Guidelines.	
Reference	Rural R&D Corporations. (2018). Cross-RDC Impact Assessment Program: Guidelines.
Abstract / summary	<p>The impact assessment guidelines provide an overview of impact assessment methodology. This includes:</p> <ul style="list-style-type: none"> • The research project life cycle • Cost-Benefit Analysis • The impact assessment process • Assessment of non-market impacts • Sensitivity analysis and reporting <p>The impact assessment guidelines were written for two types of audiences. The first were stakeholders and their representatives who are interested in understanding how RDCs assess the returns to their investments both for reporting purposes and for resource management, and to provide a means of interpreting the resulting measures. The second audience was the analysts employed by RDCs who undertake impact assessments on their behalf. The guidelines do not provide technical detail as these are provided by the companion set of procedures.</p>
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • The guidelines define research outcomes as being: “Changes in practices, production or costs as a result of farm-level adoption of the outputs of the research and development process, or changes to market structures, institutions, laws and regulations”. Impacts are “The aggregated effects of adoption of the research outcomes including changes in total production, price and quality of outputs, or market efficiency, and spillover benefits and externalities”. Using these definitions means consistency with these recommendations.
Other notes	

23. RDC Knowledge Transfer and Commercialisation Guide	
Reference	Rural R&D Corporations. (2021). RDC Knowledge Transfer and Commercialisation Guide.
Abstract / summary	<p>This document provides principles for knowledge transfer (KT) and commercialisation to maximise the investment into R&D amongst RDCs. Eight principles are outlined:</p> <ol style="list-style-type: none"> 1. Invest in impactful innovation – RDCs should have a balance of impact and adoption 2. Intellectual property – ownership and rights should be covered in contractual arrangements 3. Dissemination of published works – via open access means 4. Commercialisation path to market – this should be focused on providing the strongest benefits to Australia and the industry served 5. Partnering for commercialisation success 6. Commercialising overseas – provided there is no disadvantage to Australia 7. Risk management – apply this principle to ensure effective systems 8. Impact – being clear about success
Key points relevant to the designing the integration of extension into research projects work	
Other notes	

24. A leader's framework for decision making	
Reference	Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. Harvard Business Review, 85(11), 68.
Abstract / summary	<p>In this article the authors explore the idea that <i>“that a certain level of predictability and order exists in the world”</i>. This viewpoint is grounded in Newtonian science and encourages simplifications that are useful when circumstances are ordered. However, given this assumption does not always hold true, complexity science provides a means of form a new perspective. They introduce the Cynefin framework that helps explore multiple factors in our environment and experiences that influence us in ways we can often never fully understand. The framework allows researchers to sort issues facing</p> <p>leaders into five contexts. Four of these—simple, complicated, complex, and chaotic—require leaders to diagnose situations and act appropriately depending on the context. The fifth—disorder—applies when it appears none of the other four are dominating.</p> <p style="text-align: center;">Figure 17. An overview of the Cynefin framework.</p> <p>A brief explanation of each of these follows.</p> <ul style="list-style-type: none"> • Simple contexts: characterised by stability and clear cause and effects. These contexts do not often change. They require straightforward management and monitoring. Leaders sense, categorise and respond. • Complicated contexts: contain multiple right answers and although there is a clear relationship between cause and effect not everyone sees this. Leaders in this situation must sense, analyse and respond. • Complex contexts: there are no right answers and is the domain of the unknown unknowns. Solutions need to emerge. Leaders should not impose a course of action but probe, sense and then respond.

	<ul style="list-style-type: none"> • Chaotic contexts: searching for right answers is pointless as relationships between cause and effect are shifting constantly and there are no patterns. Leaders need to act (to establish order), sense (where stability is present) and then respond (to transform the situation and move it to complexity).
<p>Key points relevant to the designing the integration of extension into research projects work</p>	<ul style="list-style-type: none"> • “Good leadership requires openness to change on an individual level”. (p.8)
<p>Other notes</p>	

25. Theory of Change Primer, A STAP Advisory Document	
Reference	Stafford Smith, M. (2020). Theory of Change Primer, A STAP Advisory Document. Retrieved from https://stapgef.org/resources/advisory-documents/theory-change-primer
Abstract / summary	This document provides a synthesis of guidance specifically aimed at Theory of Change (ToC) processes in a Global Environment Facility (GEF) context, as part of a growing suite of Scientific and Technical Advisory Panel (STAP) documents that support the design of interventions in meeting the GEF’s goal to apply leading practices to deliver transformational change. ToC interacts with many other elements of the project and program design. In this primer, these interactions are only discussed briefly in terms of their implications for ToC and cross-references to other STAP, GEF or external sources are often provided for more detail. In drawing up this primer, STAP spoke with diverse practitioners in the GEF family, whose inputs were greatly appreciated. A wide range of sources, online and in the peer-reviewed literature, were also reviewed.
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Before developing a TOC, <ul style="list-style-type: none"> – Conduct a stakeholder analysis to help decide who should be involved – Prepare statements of the problem and intended goal after solving the problem – Limit the length of the workshop session to avoid participants losing focus and limit the number of people involved (ideally between 3 to 15) • Confirm problem and goal <ul style="list-style-type: none"> – Ensure everyone is on the same page by circulating key documents before the workshop. Get everyone to agree on the overall goal and problem statements and definitions (although do not spend too much time on wordings as ToC is an iterative process). Note that the statements will need to be brought up repeatedly to prevent the discussion from deviating from the right path. – Note if the disagreement is heated, then it means it’s not a good time to proceed into ToC. • Work backwards to outcomes and outputs <ul style="list-style-type: none"> – What the goal is → what are the long-term outcomes in order to deliver this goal → what are the short-term outcomes needed to achieve them → what are the outputs needed to achieve each of the outcomes – Have a discussion around which outcomes are really necessary and which are not • Define causal pathways and assumptions <ul style="list-style-type: none"> – Link the outputs and outcomes, and then show how they contribute to the overall goal. Use arrows to link them to represent the logic and causal relationship – The goal is to identify and document important causal relationships, not every one of them. Remind participants to reflect again on if these linkages are necessary and sufficient before finishing the discussion • Explore barriers and enablers <ul style="list-style-type: none"> – Identify barriers and enablers for each pathway, including the influences between them rather than just factors from the outside – Add any additional outputs, outcomes, or pathways to overcome the barriers – Bring fresh eyes into this step • Check evidence, adequacy and plausibility <ul style="list-style-type: none"> – The number of main pathways should be limited to achieve the best outcome (usually no more than 6) – Use the existing evidence to support the pathway • Define activities and complements <ul style="list-style-type: none"> – Identify pathways that are realistic to achieve within the scope of your intervention – Clarify what type of activities are needed to initiate these pathways without going into the details in the workshop • Set up monitoring, evaluation, and learning • Summarise and explain the ToC • Consider structured iteration and review process

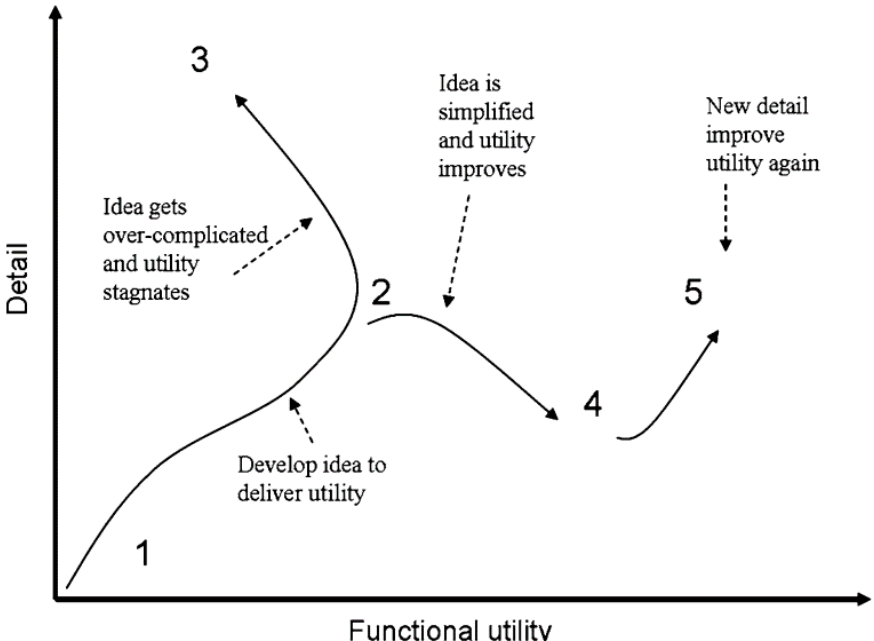
Table 2. Stages of developing a theory of change.

Purpose		Implications for process of ToC exercise	Result
Design	Initial framing	Hold a small group brainstorm Make initial iteration a swift exercise ToC may be broad, with limited depth	Problem, goal, basic design and scope of intervention are defined. Key causal pathways sketched and their sufficiency assessed
	Deep design	Engage a wider group with new perspectives Run more detailed iterations (e.g. half-day workshops) with strong facilitation Develop comprehensive pathways and test logic deeply	Design now tested with insights from wider key perspectives Basis for ToC in proposal now well developed (may need to include some engagement too)
Engage	Team and partners	Run intensive workshop(s) with full team Needs strong facilitation and resolution of disagreements together Bring all to same understanding	Team and partners own and understand the approach, to ensure consistent implementation
	Wider actors	Run bigger group workshop Accept that process is more important than content (may be better to focus on fewer key pathways)	Stakeholders accept and own the approach, to help ensure scaling out, up and deep, and for durability
Communicate	Internally	Summarize underlying ToC logic in forms that are found useful, maybe in multiple formats (e.g. logframe)	Any changing staff or partners rapidly understand the project intent
	Outside world	Illustrate major pathway narratives that resonate with and explain the intervention	Public, community and stakeholders are supportive
Measure	Adaptive learning	Emphasize assumption testing and progress on nearer-term outcomes Explore adaptive implementation in response to new evidence and contexts	Learn from progress Justify necessary (but not open-ended) flexibility in implementation
	Post hoc evaluation	Test links between shorter- and longer-term outcomes Implement evaluation and learning for funders	Confirm that near-term outcomes predict eventual impact Meet formal evaluation

Abbreviations: ToC, Theory of Change.

Other notes

26. Theory of Change Supplement: A short literature review and annotated bibliography, A STAP Background Document	
Reference	Stafford Smith, M. (2020). Theory of Change Supplement: A short literature review and annotated bibliography, A STAP Background Document.
Abstract / summary	This supplement document to the Theory of Change Primer collates some grey and reviewed literature as context to confirm that the RAPTA framework is up to date. Definitions of ToC are surprisingly diverse, although they all indicate that a ToC makes explicit the logic of how an intervention is expected to produce results.
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Common ToC steps emerged from the lit review: <ul style="list-style-type: none"> – Set goals according to the high-level changes that we want to achieve – Work backwards to identify the preconditions of the goal – Explain assumptions – Design a set of milestones/indicators to gauge the process – Write up a narrative • It is essential to engage a range of people, including practitioners, volunteers, managers, service users, and external stakeholders, to bring in different viewpoints and help the group think through all possible causal pathways • ToC is an iterative and ongoing process and thus should be applied through the entire intervention lifecycle • Measures and indicators should be developed for each of the outcomes and ideally address the four elements – how, who, what, and when
Other notes	

27. Requisite Simplicities to Help Negotiate Complex Problems	
Reference	Stirzaker, R., Biggs, H., Roux, D., & Cilliers, P. (2010). Requisite Simplicities to Help Negotiate Complex Problems. <i>Ambio</i> , 39, 600-607. doi:10.1007/s13280-010-0075-7
Abstract / summary	Decision-makers responsible for natural resource management often complain that science delivers fragmented information that is not useful at the scale of implementation. We offer a way of negotiating complex problems by putting forward a requisite simplicity. A requisite simplicity attempts to discard some detail while retaining conceptual clarity and scientific rigour and helps us move to a new position where we can benefit from new knowledge. We illustrate the above using three case studies: elephant densities and vegetation change in a national park, the use of rules of thumb to support decision making in agriculture, and the management of salt in irrigation. We identify potential requisite simplicities that can allow us to generate new understanding, lead to action and provide opportunities for structured learning.
Key points relevant to the designing the integration of extension into research projects work	<p>To form a requisite simplicity, we (researchers) need to</p> <ul style="list-style-type: none"> • Move outside the specialist areas, acknowledge and work with other domains such as culture and experience (from farmers) and spend time learning together • During the process, ensure stakeholders representing different interests and disciplines do not lose a shared view to avoid investigating in too many details and overshoot the problem • Reframe the problem in a way that's actionable when potentially moving toward position 3 in the simplicity cycle (refer to Figure 18) • Know the components involved in the problem and identify the robust integral properties • Reposition ourselves (researchers) as learners in the complex system, acknowledge errors and embrace failure to avoid false uncertainty
Other notes	<ul style="list-style-type: none"> • Note that complex problems/systems in this case refer to the nature of the problem having multiple components and non-linear relationships between them rather than the difficulty level • Simplification is to reduce the problem to its core components and provide a more elegant way going forward  <p style="text-align: center;">Figure 18. The simplicity cycle.</p>

28. Theory of change basics: A primer on theory of change	
Reference	<i>Taplin, D. H., & Clark, H. (2012). Theory of change basics: A primer on theory of change. New York NY: ActKnowledge.</i>
Abstract / summary	“Theory of change is a rigorous yet participatory process whereby groups and stakeholders in a planning process articulate their long-term goals and identify the conditions they believe have to unfold for those goals to be met. These conditions are modelled as desired outcomes, arranged graphically in a causal framework.”
Key points relevant to the designing the integration of extension into research projects work	<p>This process involves:</p> <ul style="list-style-type: none"> • Identifying the different interventions (each one is linked to an outcome in the framework) • Allocating one or more indicator to each outcome (the measurable evidence that enable you to monitor progress towards achieving a goal) • Including rationales (these explain the connections between the outcomes) • Clarifying assumptions (the conditions that stakeholders believe are necessary for success) • Writing a narrative (this explains the logic behind the theory of change) • Identifying long term outcomes (the changes you strive for as a result of your intervention). • Mapping causal pathways (these indicate the order in which outcomes need to occur in order to reach your ultimate goal). <p>Once your theory of change has been developed, a quality review should be undertaken, this assesses the plausibility, feasibility and testability of your framework.</p>
Other notes	

29. Social principles for agricultural extension to assist in the promotion of natural resource management	
Reference	Vanclay, F. (2004). Social principles for agricultural extension to assist in the promotion of natural resource management. Australian Journal of Experimental Agriculture, 44(3), 213-222.
Abstract / summary	“An understanding of social issues, the social nature of farming, and the social basis of adoption is needed if agricultural extension is to be effective in addressing natural resource management issues, and in promoting sustainability in its triple bottom line conceptualisation. Twenty-seven principles are presented here, with the key principles being: awareness of farming as a social activity; recognition of the social diversity of farmers and the social drivers in agriculture; and the socio-cultural basis of adoption.”
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Farming is not just a technical activity, rather it is a socio-cultural activity. Therefore, it is guided by social practices. • Farmers are diverse – which means there is no one size fits all extension solution. • Rather than thinking of farmers in demographic groupings (for example, by age, farm size, land type, etc.), it can be useful to think of them in sub-cultural groupings (or styles of farming). These groups take into account their priorities, understanding, values, ways of working, etc. • Adoption is a socio-cultural process, rather than farmers passively adopting scientific ideas, it is a deliberate decision by farmers to engage. In the adoption process farmers discuss the ideas or practice with other farmers. • Profit is not the only driver for many farmers, they seek to balance this with lifestyle factors. • Good farm management means different things to different people, it is typically influenced and shaped by a range of factors (including, other farmers, extension officers, information, etc.). • Farmers view the farm system as a whole, and therefore breaking things down into individual components does not resonate with them – it must be integrated with the whole system. • Farmers gain knowledge and information from a range of sources and through their own experiences. For farmers to adopt science, it must be consistent with their own knowledge and world view. • Extension must have farmer needs at its core, and be more than a one-way flow of information. • There are a range of reasons for non-adoption, these are: <ul style="list-style-type: none"> – Too complex – Not easily divisible into manageable parts – Not compatible with farm and personal objectives – Not flexible enough – Not profitable – Capital outlay is too high – Too much additional learning is required – Risk and uncertainty is too great – There is conflicting information – Don’t see that there is a problem – Lacking the physical infrastructure – Lacking the social infrastructure. • Farmers no longer just accept science and extension as being credible.

	<ul style="list-style-type: none">• Farmer representatives typically are not representative of all farmers (farming styles, world views, etc.).• Extension should be multi-method to best deliver to a range of different farmers.• Extension is important and valuable, but realistic expectations need to be placed on how much change will occur as a result of extension activities.• Farmers are making significant financial investment in the area of natural resource management and need to feel valued for this investment.
Other notes	

30. Making sense of complexity: using SenseMaker as a research tool	
Reference	Van der Merwe, S. E., Biggs, R., Preiser, R., Cunningham, C., Snowden, D. J., O'Brien, K., Goh, Z. (2019). Making sense of complexity: using SenseMaker as a research tool. <i>Systems</i> , 7(2), 25.
Abstract / summary	<p>In this paper the idea of sensemaking is described. Sensemaking is a cognitive process that allows us to be able to structure what we understand, what we do not know and explain the world in order to inform our action. Sensemaking is informed by a range of things, such as knowledge, experiences, culture, etc. Narratives are a critical part of sensemaking and can be used to explore social patterns. In turn these patterns can help researchers and decision makers to investigate social systems. There are a number of sensemaking research methods. However, in this paper the SenseMaker tool, based on the Cynefin sensemaking framework is described.</p> <p>The Cynefin sensemaking framework is a practical application of complex thinking. It helps classify different types of problem contexts (obvious, complicated, complex, chaotic). Using this framework narratives are fed into the SenseMaker tool allowing patterns to emerge and be identified.</p>
Key points relevant to the designing the integration of extension into research projects work	<ul style="list-style-type: none"> • Consider the SenseMaker tool as a means of understanding the world [note: would require substantial upskilling]
Other notes	

Appendix 5: Review of recent RD&E projects

In this document, we outline an analysis of recent RD&E projects that have had variable success and gather the learnings (to validate researcher assumptions and provide input into the focus groups). Each participating organisation was invited to provide an example of a project that has been successfully adopted and one where adoption was less optimal. In some cases, we have also conducted short interviews with managers from participating organisations associated with the projects provided. This has allowed us to provide some commentary on some of the projects.

Themes from the review

- It is difficult to tell from project reports whether the project has been successful or not as reporting requirements currently do not often include any evaluation of project success.
- There is considerable variation in templates across RDCs which means there are varying levels of extension details provided or needed from each project. In addition, it is not clear from some reports whether the research was demanded from the market.
- The impacts of COVID-19 often delayed the development of tools and resources, as well as caused the cancellation of physical activities.

Recommendations

- Consider the structure for final reporting – providing basic headings/questions to answer specifically when considering project success (e.g., Cotton Australia has a template that includes a listing of project outputs and outcomes from project outputs).
- Consider the benefits of alternative reporting mechanisms (e.g., short videos summarising what has been learnt/important for the industry could be more useful for end-users/levy payers).
- Consider developing a checklist for project submission (there are several RDC templates such as AgriFutures).

Adoption pathways or strategies related to extension and adoption provided by each RDC are listed in the appendix.

AgriFutures

Overview	AgriFutures Australia is the trading name for the Rural Industries Research and Development Corporation (RIRDC). It's an organisation that focuses on the future of Australian agriculture and aims to grow the long-term prosperity of Australian rural industries.
Example of well adopted project	Not provided.
Example of a research project that was less successful	Not provided.
Notes on success factors	<p>Within the Open Call template,</p> <ul style="list-style-type: none"> • The evaluation criteria consider the research project's applicability, including questions such as: <ul style="list-style-type: none"> – How much value do the benefits of this research provide to industry? – The potential for adoption in industry. – The potential for commercial pathways. • It also requires the proposal to clearly indicate: <ul style="list-style-type: none"> – The plan for extension and adoption of research outcomes from the project activity work, i.e. beyond distribution of summaries, journal papers and conference presentations. • The extension component is also clearly outlined in the submission checklist: <ul style="list-style-type: none"> – Does the proposal clearly articulate what the applied outcome for industry will be? (even if it is a long-term applied project there should still be a focus on an applied outcome). – Does the proposal clearly outline what the potential process might be for identifying extension opportunities? (Excluding publications and opportunities for presenting the work at conferences). <p>AgriFutures encourages the projects to communicate research to industry</p> <ul style="list-style-type: none"> • AgriFutures Australia Research and Provider Agreements outline the obligations of Principal Investigators and Research Organisations regarding project communication. A communication guidelines section is included in the Researchers handbook, detailing <ul style="list-style-type: none"> – Process of signing off by AgriFutures before distribution – The use of AgriFutures logo – AgriFutures communication templates (e.g., report, fact sheet, PowerPoint) are encouraged to be used – Acknowledgment of AgriFutures. • AgriFutures Australia will also communicate the project information/progress back to the industry in their own channels by asking for information/interview from the projects.

Australian eggs

<p>Overview</p>	<p>Australian Eggs provides marketing and research and development services for Australian egg farmers. They work to try and develop targeted research that has clear pathways to on-farm adoption.</p> <p>Australian Eggs expects a final project report to be academic and that they will translate this into farmer-ready resources. This process is under review at present, especially to determine whether reliance on the final report is the best way of achieving what's needed.</p>
<p>Example of well adopted project</p>	<p><i>Best practice lighting management for Australian layers</i></p> <p>This report (Hewitt, 2018) outlines work reviewing research and best practice on lighting for laying hens. The aim was to recommend further research and extension in order to keep improving practices in the industry. A large number of research recommendations were made. Key extension recommendations were focused on technical data including:</p> <ul style="list-style-type: none"> • Tools for the measurement of light • Information on the use of light and potential hazards (e.g. smothering of chicks) • Information on light as it affects production and health of hens • General information on the use of light for laying hens. <p>The factors that contributed to this being a well-adopted research project were:</p> <ul style="list-style-type: none"> • The researcher presented at the Australian Eggs 2019 mini forum • A series of posters were made on the topic.
<p>Example of a research project that was less successful</p>	<p><i>Resilient plants to entice hens outdoors on free range farms</i></p> <p>The aim of this project (de Koning, 2020) was to consolidate information on what to plant on free range layer farms. Key conclusions were:</p> <ul style="list-style-type: none"> • The importance of perennial pasture plants as they provided some ground coverage when annuals had died. • Close to the shed the ground cover is stripped by hens as they do not venture to the edges as much, particularly when temperatures go over 25°C. This also results in a higher weed concentration closer to the shed. • Oldman saltbush was found to be a useful plant, especially in drier climates. • Trees and shrubs were critical parts of the range for hens, providing shade, shelter and dustbathing opportunities. These trees needed protection around the roots especially when hens were stocked at 10,000 hens/ha. • Guidelines were produced that provides novice farmers information on how and what to plant. <p>The factors that contributed to this being a well adopted research project were:</p> <ul style="list-style-type: none"> • While the information is useful, it's not in demand by many egg farmers. Additionally, the title of the project and the main publication probably missed the mark. • Farmers want to know how to keep their ranges free and low maintenance and they're less concerned with 'enticing hens onto the range'. • There was supposed to be another output from the project, a digital repository of poisonous plants, but it didn't eventuate. • The completion of the project coincided with the COVID-19 pandemic. The researcher would have done a tour of the country, talking to various egg farmers about range management, but COVID interrupted that. • In hindsight, it may have been better to have made some short information products, rather than the one large manual. For example, the case studies could have been produced as separate PDFs.

	<ul style="list-style-type: none"> In summary, this project was not solving a high priority industry problem and did not have a solid extension plan (while it was known what outputs would be created, insufficient thought was put into the promotion/ dissemination of these).
<p>Notes on success factors</p>	<p>Australian Eggs have developed a Research Project Extension Plan. The project manager is responsible for developing the project’s extension plan, in collaboration with the team. The extension plan requires an output timeline and communication strategy. The relevant sections to extension include:</p> <ul style="list-style-type: none"> Capturing the following key project information: <ul style="list-style-type: none"> Target audience or end-user Project outcome/s Research type. Assessing the opportunities for developing outputs (such as Eggstra articles) during the project. Selecting which outputs would be most effective for communicating the outcomes to the end-user.

Cotton RDC

<p>Overview</p>	<p>A program-level Adoption Pathway process was developed to consider the opportunities to impact awareness, understanding and behaviour change during the lifetime of the research project.</p> <p>Within each program area, the adoption pathway development process involves six steps. Those related to extension are:</p> <ol style="list-style-type: none"> 1. Define the problems and controversies in each production area that are the focus of change. 2. Identify the technologies that extension programs can be built around as well as provide a gap analysis of opportunities. 3. Consider the stage of development of the technology – looking into potentials to engage other stakeholders and end-users. 4. Work through the CottonInfo extension planning framework for the issue being researched. This provides a foundation to inform activity planning, including the use of the most appropriate extension model. 5. Consider the level of skills acquisition – this will decide the scale of engagement (from general to specific). 6. Identify adoption characteristics of the technology being researched as they can be both motivations and barriers to change. <p>The extension planning framework, level of skills acquisition, and adoption characteristics, adoption pathway milestones were included in the template.</p>
<p>Example of well adopted project</p>	<p><i>IPM Technical Lead and Pest Management for High Yield Research</i></p> <p>IPM (Grundy & Holman, 2021) provided strategic leadership for pest management and resistance stewardship across the cotton industry while also conducting research to understand better the relationship between early season fruit retention and the pursuit of very high yields.</p> <p><i>Key conclusions of the Retention for High Yielding Bollgard® 3 Research were:</i></p> <ul style="list-style-type: none"> • This research has confirmed that cotton crops compensate effectively for early square loss and achieve high yields. • The process of compensation is rapid and not reliant on additional fruiting branch production, but rather is a process of substitution of fruiting sites on existing expanding branches. • Bollgard® 3 varieties are well placed to achieve timely and effective compensation, particularly for early season square loss represented by the FB 1-5 treatment. <p><i>The factors that contributed to this being a well-adopted research project were:</i></p> <ul style="list-style-type: none"> • The research was replicated throughout the industry on commercial properties (the trial sites were very close to commercial fields). • Field walks were held at the majority of the trial sites and were well-prepared. Many attendees were keenly interested in the research and participating in a conversation about crop growth and yield accumulation. • Having physical samples enabled conversation around the work and allowed attendees to think through the mechanics of compensation. • During this project, numerous extension products (videos, newsletters and industry articles) and services (field walks, workshops, training and formal presentations) were created and provided to the industry to ensure emerging issues were addressed/answered in time. • Training courses were targeted at a specific population. Doing so limited the audience reach but ensured quality upskilling for individuals and allowed them to share their learning with others. • The campaign involved a range of stakeholders across different locations. • Newsletters, videos and online forums reinforced messages presented at these meetings to ensure the rapid dissemination of updated information. • A survey was used to identify opportunities for content improvement.

<p>Example of a research project that was less successful</p>	<p><i>Mitigating & managing soil compaction for sustainable cotton production</i></p> <p>Soil compaction is a hidden and continuing constraint to cotton productivity. This project (Braunack et al., 2017) aims to understand how the industry currently identifies soil compaction as an issue and current strategies to ameliorate/mitigate it through extension-based events (e.g., workshop, forum, on-farm visits). Key conclusions were:</p> <ul style="list-style-type: none"> • The project has identified that soil compaction is an issue for the cotton industry, even though it's not acknowledged publicly and the industry perception towards it varies. • The industry is further recognising soil compaction by modifying the track width of pickers (to 3m or even 4m) to minimise the area trafficked. • Currently, there is no long-term information or valid evidence on which crop rotation sequence or tillage operations actually improves degraded soils. • It takes time for the response to occur once a change is made. • The depth effect and management approaches seemed to prompt the understanding the agreement that compaction is an issue for the industry. <p>Reasons that soil compaction is NOT a well-recognised issue</p> <ul style="list-style-type: none"> • There is a lack of practical information available to: <ul style="list-style-type: none"> – convince growers that soil compaction is a problem. Soil compactions tend to be underappreciated because it's invisible. It got worsened when crop yields, in fact, increased. – guide them to manage it. Growers are making changes with little or no knowledge of its necessity and potential benefit. • Two main approaches used are modifying the track width of pickers and crop rotation. However, <ul style="list-style-type: none"> – there is no knowledge about the potential yield losses incurred due to picker traffic - there is a need to quantify the cost of in-field picker traffic. – there is little tangible evidence that rotation crops are remediating soil compaction, largely due to the fact that the common rotation is one cotton crop followed by a rotation crop and back to cotton. Overseas research has indicated that it takes much longer for crop response to be observed (10-15 years).
<p>Other notes</p>	<ul style="list-style-type: none"> • Use the key themes that emerged from the field walks to plan for future research – address assumptions that hinder the adoption by providing more scientific evidence to facilitate trust-building between advisors and growers (Grundy & Holman, 2021). • All parties involved with the project need to be actively engaged and committed for the best outcome to be achieved, which requires time to be allocated commensurate with the commitment (Braunack et al., 2017). • Messages for extension going forward from IPM extension (Grundy & Holman, 2021) include: <ul style="list-style-type: none"> – Identify target audience during research rather than solely depending on advisors to influence their clients. – Begin with the evidence before considering applicability and consider gaps that may need to be overcome. This may entail collaboration with the researcher to consider and demonstrate the applicability. – Provide mechanisms for people to consider certain scenarios or information and be confident in not taking action as an appropriate response in such scenarios. – Re-enforcing foundation knowledge rather than assuming that clients have a foundational knowledge of basic topics. – Discouraging faulty thinking – this will be difficult but worth exploring.
<p>Notes on success factors</p>	<p>In their FRP template, sections relevant to extension include:</p> <ul style="list-style-type: none"> • Project summary needs to provide an overview of how the R&D project will benefit the cotton industry. The project summary is expected to be published on CRDC website. • Project “Pathway to Impact” is required to be detailed in proposal, allowing CRDC to assess the capacity of the project personnel to effectively translate research/project outcomes to

	<p>on ground actions. The section requires descriptions about target audience and process for extension/communication/commercialisation (as appropriate), as well as any collaboration partners and potential risks. The successful FRPs may be requested to develop specific milestones for delivery of project outcomes in collaboration with CottonInfo or CRDC Commercialisation Manager at the outset of the project.</p> <ul style="list-style-type: none">• Research projects are required to describe any proposed collaborations for the project and / or the collaborative networks of the project team generally.• Research projects are required to detail the commercialisation potential of any possible intellectual properties created in the project. <p>Report templates</p> <ul style="list-style-type: none">• The final report template (2021) includes tables listed the outputs produced and outcomes from the outputs.• The final report template (2017) asks descriptions about how the project’s outputs have contributed to the planned outcomes identified in the project application to date as well as extension opportunities for future.
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Dairy Australia

<p>Overview</p>	<p>Dairy Australia works with industry partners to coordinate major activities, deliver services to dairy farmers, and respond quickly to changing priorities and issues. Dairy Australia works closely with eight Regional Development Programs, which are referred to as our ‘regions’. These organisations are the main interface between Dairy Australia and dairy farmers. They are geographically based in three regions of Victoria – Gippsland, Western Victoria and the Murray, as well as New South Wales, Subtropical, Tasmania, South Australia and Western Australia. Each Regional Development Program consists of a Board, a Regional Manager and a team dedicated to extension, development projects and communications across the region. Their primary role is in the facilitation and delivery of Dairy Australia extension activities and regional initiatives.</p>
<p>Example of well adopted project</p>	<p><i>DairyFeedbase</i></p> <p>What it has achieved since 2018</p> <p>DairyFeedbase (<i>Dairy Feedbase Mid-Term Review, 2021</i>) seeks to make transformational improvements to pasture productivity, grazing management and dairy cow nutrition. Each of the five DairyFeedbase projects has made notable research achievements which, in some cases, are now ready for development and delivery to the dairy industry.</p> <p>Some of the work that the projects are doing that involves the adoption</p> <p><i>Pasture Smarts – Improved on-farm agronomy decisions</i></p> <ul style="list-style-type: none"> • The team is working with 6 commercial farms as well as the Ellinbank research farm to calibrate sensors across a range of farm practices and regional conditions. A further 14 commercial farms have been engaged for validation studies. • This discovery work has been translated into the creation of a smartphone app intended to enable farmers to remotely assess the feed wedge and pasture mass pre- and post-grazing across their properties. A task group will facilitate the development of the app, and 20 cooperating farms will test the prototype. <p><i>First 100 days – Nutrition of cows during the first 100 days of lactation</i></p> <ul style="list-style-type: none"> • Demonstration of the economic benefits (or otherwise) of nutritional strategies is a clear strength of this project which should be persuasive to farmers, nutrition advisors and feed companies. <p><i>Forage Value Index Futures – More confident choice of pasture cultivars</i></p> <ul style="list-style-type: none"> • FVI Futures has a well-defined and credible path to market through its strong engagement with the seed industry. • Industry engagement is also supported by the hosting of DVI reporting on the Dairy Australia website. • Demonstration of the economic value of superior pasture cultivars to farmers <p>However, there was no compelling evidence of a sophisticated, well-informed strategy to support translation, commercialisation, adoption and utilisation of DairyFeedbase research findings and outcomes for most of the projects.</p> <p><i>The Virtual herding technology</i></p> <p>The Virtual herding research project is in its initial stages of commercialisation as a form of automated and digitised livestock management.</p> <p>Social research will be conducted with stakeholders to identify considerations and challenges for integrating and adopting Virtual Herding on farm. Activates planned include:</p> <ul style="list-style-type: none"> • Literature review (meta-analysis).

	<ul style="list-style-type: none"> • Focus group with scientists, farmers, farm advisors, policymakers and community stakeholders. • Farm case studies through farm interview, data collection and whole farm system modelling. • A cross-industry assessment and risks, costs, and benefits. <p>Regardless of whether the adoption is societal-, market-, or customer support-driven, the adoption pathway needs to provide a dedicated role for science to inform what applications are valid and acknowledge the animal behaviour elements of this technology.</p> <p>Supporting adoption requires strong leadership, cross-industry collaboration and working at multiple levels (from policy to on-the-ground participation). Specifically, recommendations for industry bodies include:</p> <ul style="list-style-type: none"> • React to emerging adoption challenges and proactively inform the public about the technology (e.g., through education campaigns). • Work with regional bodies or rural professionals to monitor the usage of the technology. • Develop industry guidelines or best management practices for using the technology responsibly and ethically to minimise socio-ethical risks. • Use proven applications to build trust in the functionality of the technology among end-users. <p>Other design principles include:</p> <ul style="list-style-type: none"> • Recognise that the value position and approaches to adoption are likely to vary according to industry, region, farm system, producer attitudes and change over space and time. Therefore, customisation and flexibility are required. • The analysis and evidence of the technology should keep evolving. <p>Forming Communities of Practice could provide support and learn toward the farming community.</p>
<p>Example of a research project that was less successful</p>	<p><i>Our Farm, Our Plan</i></p> <p>This project (<i>Our Farm, Our Plan Steering Committee FY21 Report, 2021</i>) has been designed and developed to significantly increase the proportion of farmers with effective strategic plans. The project delivers a rapid expansion of services to increase farm business skills, including:</p> <ul style="list-style-type: none"> • build required capability in the Australian dairy industry. • create motivation to participate in the program. • deliver extension that achieves adoption and practice change through group-based and individual engagement, online resources and stand-alone resources. <p>One of the key challenges in year one includes increasing farmer participation. Reasons that hindered the participation number from meeting the target include:</p> <ul style="list-style-type: none"> • Underestimate the effort required to increase awareness. • Underestimate the level of resource needed to work with farmers to undertake a program of this nature. • A tool designed to provide a digital pathway and easy access for farmers was delayed. • Other factors such as the disruptive year.
<p>Notes on success factors</p>	<p>The Project initiation template requires the projects to</p> <ul style="list-style-type: none"> • Define the target audiences. • Outline the economic, social, and environmental benefits. Specifically, social benefits to the dairy sector.

Fisheries RDC

<p>Overview</p>	<p>A National Fisheries and Aquaculture Extension and Adoption Strategy was developed by a working group made up of extension specialists, industry, fisheries managers and lead researchers. This is now a component of Working Together: The National Fishing and Aquaculture RD&E Strategy 2010. The Extension and Adoption Strategy outlined five key principles for Extension and Adoption. These have been adopted as key principles to follow to encourage and promote extension and adoption. They are:</p> <ol style="list-style-type: none"> 1. All stakeholders to value extension and adoption activities in the same way as research activities. 2. Extension will be a key focus in research project development. 3. Project knowledge and outputs are actively managed. 4. Effectiveness and impact of project extension activities are evaluated. 5. Extension and adoption capacity is maximised and built upon. <p>The FRDC set up the Human Dimensions Research (HDR) Coordination Program. This program is responsible for setting R&D priorities to maximise investment in human dimensions research, with a focus on social, economic and cultural factors and the people, markets, institutions and behaviours these affect.</p> <p>FRDC completed a review of extension and adoption activities and approaches that have been and are being used in the fishing industry (Jennings et al., 2011). The following recommendations were made:</p> <ul style="list-style-type: none"> • Continue the current applications of extension methods as they are considered to be working well. • Continue and strengthen the work of the Fisheries and Aquaculture Extension and Adoption Network and consider joining professional association groups such as the Australasian-Pacific Extension Network. • Encourage professional development and training in extension for members of the fishing industry, particularly those people engaged in extension delivery. • Improve existing capacity to enable change by better connecting the boats of the industry with the boardrooms. Currently this is focused on project and program support. • Establish coordinated communication hubs at the state-regional level to better enable change and promote the role of extension throughout existing RDEA activities. Embrace social networking and other electronic media.
<p>Example of well adopted project</p>	<p><i>Regional impact assessment for the marine protected areas proposed for the south-east region</i></p> <p>This report (Buxton et al., 2006) outlines work undertaken to explore the impacts of 14 proposed Marine Protected Areas (MPAs) in the South-east Region of Australia. The authors explored the displaced catch, although did not calculate changes in net income of fishers or the value of lost fishing entitlements. Part of the work involved 11 case studies which explored sociological impacts. They found that sociological impacts were complex, including job losses, but they concluded that fishers would remain in the industry under pressure. This would have impacts on adjacent areas. They also highlighted that most of the impact would be on Tasmanian fishers. They recommended that an alternative MPA be established which still met the requirements for biodiversity conservation but decreased the impacts on fishers.</p>
<p>Example of a research project that was less successful</p>	<p>Not provided.</p>

Notes on success factors	<p>It is an FRDC requirement that an Extension and Adoption Plan is developed and submitted for every project. This requires project managers to have given some thought to how the project outputs will be used and adopted by end-users when developing the application. The Extension and Adoption Plan provides information that assists project staff in developing their plan.</p> <p>The major sections are as follows:</p> <ul style="list-style-type: none"> • Objectives • Target audience/s • Key message/s • Methods • Action plan • During project • After project • Evaluation. <p>Proposed changes to FRDC research application procedures:</p> <ol style="list-style-type: none"> 1. Cease the existing extension and adoption plan and integrate extension and adoption prompting questions below into “background/need” “pathways to impact” “methods” and “extension” questions into the current form. 2. Provide an explanatory guide on 1 above. 3. Add an extension and adoption resources page to the FRDC website. 4. Change the website to reflect the above. <p>The following is a draft of the proposed questions referred to above.</p> <ul style="list-style-type: none"> • Background/need <ul style="list-style-type: none"> – Who are the end-users (e.g. fishers, managers) or target audiences (e.g. general community) of the project? – Have you consulted with end-users or target audiences and included their input or interests into the project design? – Who are the beneficiaries (e.g. community, industry) of the project and how will they benefit from the project? • Pathways to impact <ul style="list-style-type: none"> – How are project outputs going to lead to adoption by the identified end-users, including any assumptions and partnership requirements. – What proportion of end-users are likely to adopt research outputs? – What is the timeline for adoption? – How will the identified beneficiaries (e.g. community, industry) benefit from the project? • Extension <ul style="list-style-type: none"> – If your project requires extension - have you consulted with an extension specialist or FRDC extension officer? – Are the project outputs relevant for other management authorities or industries? If so, how are the project outcomes going to be communicated to other interested stakeholders? – What are the proposed extension and communication methods and why have they been chosen?
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<p>Overview</p>	<p>Hort Innovation has launched a new Extension initiative to ensure communication and extension activities support business decisions and enhance practices on farm. Hort Innovation works with its partners – such as industry groups, universities and government agencies – to deliver projects for horticulture levy payers. The extension initiative enhances the coordination, communication and application of research and development outcomes, and includes a team of Regional Extension Managers, working in the regions. These managers play a linking role to share skills and capacity and solve identified regional problems. Collaborative approaches to solving regional problems enable tangible outcomes for growers to use on farm. The Extension Framework has been designed to complement other work.</p> <p>Regional Extension Managers operate in six horticulture regions that have been identified for targeted extension.</p> <p>The Extension Team strategy is outlined below.</p> <p>Objective</p> <p style="background-color: #4a7c59; color: white; padding: 5px; text-align: center;">Increasing the on-ground impact of levy investments that helps growers develop their competitive edge.</p> <p>Imperatives</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="background-color: #4db6ac; padding: 5px;">Build capability with industry and levy payers in managing Hort Innovation extension investments.</td> <td style="background-color: #5e35b1; color: white; padding: 5px;">Enhance coordination and support of existing extension networks and activities with emphasis on across-industry collaboration.</td> <td style="background-color: #ff9800; padding: 5px;">Amplify the relevance of and demand for investment outputs.</td> <td style="background-color: #3f51b5; padding: 5px;">Enable investment delivery and resulting end user change.</td> </tr> </table> <p>Actions</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="background-color: #e0f2f1; padding: 5px;"> Efficient management of the Industry development portfolio. Support delivery partners and Hort Innovation personnel in defining project impact pathways and monitoring and evaluation methodology. Build capability, mentor and develop existing extension personnel through annual professional development opportunities, networks, linkages and support. Keep up to date with best practice and innovative approaches to enable effective, efficient and coordinated service delivery. </td> <td style="background-color: #e1bee7; padding: 5px;"> Develop regional work plans for Regional Extension Managers based on identified local needs, priorities and delivery mechanisms for Hort Innovation relative to other providers. Foster greater connections with delivery partners and other extension providers (such as private sector consultants, resellers and agronomists). Develop networks within regions and work with regional leaders, delivery partners and key stakeholders with a deep understanding of unique local environmental characteristics. Identify opportunities to invest in initiatives to address significant issues that cut across industries through existing and alternative funding programs. </td> <td style="background-color: #ffe0b2; padding: 5px;"> Utilise the Hort Leadership Network to provide input into and advocacy for key investments. Seek purposeful opportunities to actively participate in and support regional industry events / associated meetings, updates, field days and field walks. Seek opportunities to support the collection of qualitative and quantitative evidence demonstrating positive investment outcomes and business impact across each fund documented. </td> <td style="background-color: #e1eef6; padding: 5px;"> Provide Hort Innovation key staff with regional information, insight into investment opportunities and industry intelligence. Utilise Hort Innovation datasets to support segmentation and shape future investments. Actively encourage third party influencers to attribute levy and commonwealth investments as the source of their information. </td> </tr> </table>	Build capability with industry and levy payers in managing Hort Innovation extension investments.	Enhance coordination and support of existing extension networks and activities with emphasis on across-industry collaboration.	Amplify the relevance of and demand for investment outputs.	Enable investment delivery and resulting end user change.	Efficient management of the Industry development portfolio. Support delivery partners and Hort Innovation personnel in defining project impact pathways and monitoring and evaluation methodology. Build capability, mentor and develop existing extension personnel through annual professional development opportunities, networks, linkages and support. Keep up to date with best practice and innovative approaches to enable effective, efficient and coordinated service delivery.	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<p>Example of well adopted project</p>	<p><i>Soil Condition Management – Extension and Capacity Building</i></p> <p>The report on this project (Rogers & Montagu, 2018) known as Soil Wealth, developed a strong presence in the vegetable industry. Soil Wealth communicated good practical soil management information to Australian vegetable growers, for a better economic outcome through:</p> <ul style="list-style-type: none"> • Building soil organic matter and structure • Covering the soil (mulches, cover crops) • Less tillage (controlled traffic, reduced-till, GPS guidance) • Correct nutrition. <p>Soil Wealth tapped into a clear need for technically sound and practical soil management options delivered Nationally across the vegetable industry.</p> <p>Soil Wealth, together with the companion Integrated Crop Protection project (VG13078) connected with more than 1,900 growers and industry people over the three-year period. More than 1,000 people attended farm walks at demonstration sites, 150 attending workshops, 80 attending the in-depth masterclasses and 320 attending webinars.</p> <p>The project provides electronic access to the information with the website attracting more than 850 users per month, 6,600 video views, 3,500 webinar views, 1,700 Facebook followers and 560 Twitter followers.</p> <p>The Soil Wealth and ICP projects undertook a survey of 165 growers and advisers during May 2017 to determine the impact and effectiveness of the project over the last three years. Almost half (40%) of survey respondents felt well informed about the latest advancements in the vegetable industry, while a further 45% felt somewhat informed. Both growers and advisers indicated that strong knowledge gains were made in the soil management areas of cover crops,</p>								

	<p>compost, precision farming and soil biology.</p> <p>One of the key aims of the projects was to influence decision-making and practices on vegetable farms. Almost half the growers (47%) identified undertaking, or planning to undertake, activities aimed at improving soil health on their farm, because of the Soil Wealth protect. A further 43% of growers were undertaking, or planning to undertake, changes but not directly due Soil Wealth project. Eighty-six percent of growers considered it was very likely (61%) or likely (25%) that soil-health practice changes would be implemented.</p>
<p>Example of a research project that was less successful</p>	<p><i>Production of fish feed from vegetable waste</i></p> <p>This project (Ekman, 2014) examined the potential to use vegetable wastes to rear insect larvae, which can then be used as components of aquaculture feed. This project has demonstrated that black soldier fly larvae can be reared successfully on a range of different vegetable crops. While some of the results appear positive and promising, there is a clear need for a much larger research project to develop this further if the method is to find commercial application. In effect, this project has raised at least as many questions as were answered.</p> <p>The issue researched in this project would probably not be high on a grower’s agenda and therefore it’s likely that adoption is low.</p>
<p>Notes on success factors</p>	<p>The Hort Innovation Final Report Template (Dec 2021) requires the projects to:</p> <ul style="list-style-type: none"> • Summarise the outputs using monitoring data and provide a detailed list of extension activities conducted over the project life. The output descriptions include a brief explanation of how and where the output was made available and evidence of engagement by the intended audience • Detail the outcomes (e.g., awareness, knowledge, practice change, commercialisation) using monitoring data and provides evidence. • List the recommendations resulting from the project for relevant stakeholders, including practical application of the project findings and development and adoption activities that would ensure full value from the project’s findings for industry. <p>The Mandatory Response Table requires the projects to:</p> <ul style="list-style-type: none"> • Consider economic, social and environmental outcomes of the project. • Provide details of the target audience for adoption of project deliverables and the strategies for adoption, including timeframe. • Detail the specific adoption targets, e.g. region targeted, number of growers/% of total production expected to implement the new technology, etc. • Consider the critical success factors or impediments to adoption. • Use appropriate linkages to industry development and communication projects to assist in adoption.

LiveCorp

<p>Overview</p>	<p>The RD&E Blueprint was developed after extensive consultation with exporters and producers in which they identified the most critical priorities for investment. This ensures an appetite for the research funded and, ultimately, the adoption of research outcomes.</p> <p>The Blueprint was developed based on the following set of principles:</p> <ul style="list-style-type: none"> • Prioritise R&D opportunities. • Represent producers and exporters equally. • Incorporate public expectations and community sentiment. • Present an agenda that is clear but able to incorporate changing priorities. • Emphasise collaboration and prevent duplication. • Provide clarity on how decisions are made. • Judge individual projects on their merits. <p>The purpose of the RD&E Program is to invest in projects that seek to build knowledge, fill gaps in existing understanding, and develop, trial and facilitate adoption of research outputs in the areas of animal health and welfare, supply chain efficiencies and market access.</p> <p>The Management Committee is the decision-making body for the RD&E Program. They oversee delivery of the Blueprint through proper governance and management of the RD&E Program. Aspects regarding extension include:</p> <ul style="list-style-type: none"> • Ensuring extension and adoption activities identified for the project are either completed or transferred to, or progressed on, the appropriate pathway • Ensuring stakeholder communication activities on research projects is undertaken. <p>Ideas or project concepts can be brought to the LEP RD&E Program by completing a project concept brief (PCB). The PCB is developed to define any R&D concept or potential project that has been brought to the RD&E Program and intended to provide contextual information and a rationale for investment</p> <p>As a relatively small industry, LiveCrop regularly connect with its members through newsletters, direct email/conversation and social media</p>
<p>Example of well adopted project</p>	<p><i>Animal Welfare Indicators Pilot for the Livestock Export Industry Supply Chain</i></p> <p>This project proposed indicators address each of the four principles under Welfare Quality® (Good Feeding, Good Housing, Good Health and Appropriate Behaviour) and provide information on health and five elements of behaviour identified during the project (1. activity and rest, 2. mental state, 3. heat responses, 4. feeding behaviour and 5. human-animal interactions). The project also developed a scientific protocol for capturing these indicators, incorporated in regulatory reporting requirements.</p> <p>The factors that contributed to this being a well adopted research project were:</p> <ul style="list-style-type: none"> • Developed indicators and a data collection and analysis process that could be practically and immediately applied to ships. • The system was developed by a specialised committee consisting of a range of experts and industry stakeholders. • A range of support was provided to enable exporters to meet the reporting requirements (e.g., training courses, live dashboard). • Materials used for training are well-designed (content, language used, etc).
<p>Example of a research project that was less successful</p>	<p><i>Eye disease in cattle on long-haul voyages</i></p> <p>This project initially aimed to prospectively demonstrate the benefits of furnishing young cattle with suitable immunity such that their risk of developing eye disease in pre-export quarantine was diminished. However, it became apparent that this was not going to be possible because:</p> <ul style="list-style-type: none"> • Difficulty in sourcing suitable cattle on farm for the experiment – the research time needs doesn't match the reality.

	<ul style="list-style-type: none">• Difficulty in gaining a positive association with treatment as disease outbreaks are rare (needs significant disease in the control group).• Do not provide direct evidence to those best practice guidelines.
Notes on success factors	<ul style="list-style-type: none">• Seek to try to involve exporters and producers in working groups for key research projects to ensure we get practical outcomes for the industry.

NSW DPI

<p>Overview</p>	<p>NSW DPI researchers rely on external funding for their projects so the assessment criteria and the adoption expectations/plan will be dependent on the requirements of the external funding body. NSW DPI has their own internal project proposal process that is heavily weighted towards documenting budgetary/resource requirements and how much will be co-contributing relative to the external collaborator. Internal processes seek to understand whether the externally funding body requires a M&E plan for the project and, if not, researchers are obliged to utilise internal resources to help design this. The implication is that every project requires an M&E plan, presumably to ensure NSW DPI are delivering on contractual obligations.</p>
<p>Example of well adopted project</p>	<p>Not provided.</p>
<p>Example of a research project that was less successful</p>	<p>Not provided.</p>
<p>Notes on success factors</p>	<p>An important note with regards to NSW DPI internal processes is that the research progression structure is based heavily on scientific publication records. While researchers may be expected to perform extension activities such as contributing to newsletter/industry publications, workshop presentations, fact sheets etc as part of their external funding contract obligations, internal acknowledgement and rewards is based weighted more towards an academic model and measured on achievements such as peer-reviewed papers (primary or co-authorship), student supervision and conference presentation and posters.</p>

Wine Australia

<p>Overview</p>	<p>Wine Australia helps foster and encourage profitable, resilient and sustainable Australian winegrape and wine businesses by investing in research and development (R&D), building markets, disseminating market information and knowledge, encouraging adoption and ensuring compliance through our regulatory functions. They work closely with their representative organisations, wine sector bodies and their partners to support the long-term success of the Australian grape and wine community.</p> <p>Over the last few years, funding for R&D via selected tender or open calls has been limited. Research projects have mostly been funded through strategic bilateral agreements with five key research providers. These agreements allow the providers to deliver projects against targeted priorities in the grape and wine sector. For example, a 5-year, \$11.1 million co-investment agreement was signed between Wine Australia and SARDI in February 2018 to address areas such as grapevine trunk diseases, use of fungicide sprays, irrigation and dry winter conditions, fruit harvested at optimal maturity, Cabernet Sauvignon trials, and germplasm collection. The degree of focus of projects on adoption pathways varies between their research providers.</p> <p>It should be noted that the agreements are close to the end. A new approach that moves back to the open call format for research funding may take over in the future. Wine Australia has provided a list of potential focuses in the adoption area for the open call that also align with the National Agricultural Innovation Agenda:</p> <ul style="list-style-type: none"> • evidence-based path to adoption • co-design and collaboration with end-users • diverse innovation practices such as disruptive thinking and entrepreneurship • involvement of non-traditional partners. <p>Currently, there is no institutional “adoption pathway” at Wine Australia as it needs to consider the specific project objectives and be fit for purpose. An Extension and Adoption Strategy was developed and supported by a list of principles and an Adoption Pathway Checklist to guide the investment in extension and adoption activities. The document is informed by a strategic review of extension and adoption in the wine sector. The six principles include:</p> <ul style="list-style-type: none"> • Design activities in conjunction with users • Offer consistent messaging • Measure impacts • Support multiple providers and a range of access points • Focus on outcomes • Encourage and create innovation loops – not linear paths. <p>They also have a few approaches in hand to tackle adoption for different types of projects/needs (e.g., consultants to identify commercialisation pathways).</p>
<p>Example of well adopted project</p>	<p><i>Managing grapevine trunk disease</i></p> <p>Grapevine trunk diseases such as eutypa and botryosphaeria dieback contribute to grapevine decline, reducing productivity and longevity, causing considerable economic loss to the Australian wine industry. In 2013 a technical delegation from the South Australian Research and Development Institute (SARDI) and the National Wine and Grape Industry Centre (NWGIC) undertook a deliberate three-pronged approach to assisting growers in the Granite Belt – visiting vineyards to assess the problem, collecting samples and having them tested; running a technical workshop; and farm walks with practical ‘hands-on’ demonstration of how to fix the problem.</p> <p>Workshops were held and a summary of the survey results provided, followed by a comprehensive presentation on managing dieback, based on research at SARDI, NWGIC and around the world over the past decade. The workshops were concluded by outlining practical recommendations for managing grapevine trunk diseases in Australia.</p>

Example of a research project that was less successful	The Pinot Provenance research, because it was esoteric. Also, the grape objective measures work, which was unsuccessful because the market drivers and ‘who will pay’ was never factored in.
Notes on success factors	<p>The Final Project Application template requires the projects to:</p> <ul style="list-style-type: none"> • Describe the end product, target audience, adoption strategy and communication activities. • Outline the outputs and the activities to achieve those outputs. <p>The Annual Operating Plan template has a section for extension and adoption. Specifically, Wine Australia’s Regional Program requires the projects to list in order of importance the highest extension and adoption priorities for the region over the next 12 months. It also encouraged the projects to list all the activities they have planned, along with the benefits of the activities (behaviour or practice change), M&E, and final outputs. It also advises the projects to think how they will communicate the findings/outputs beyond their own region.</p> <p>Good practices mentioned in the project proposals:</p> <ul style="list-style-type: none"> • Bridge the knowledge gap (e.g., evidence to support the use and address the perceived risks). • Explore the points in the value chain where adoption may make the greatest impact. • Conduct large trials.

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Appendix 5a: Adoption pathways

AgriFutures

AgriFutures engaged Innovation Studios to develop a best practice methodology for challenge-led and open innovation for rural industries in Australia. An **open innovation model** is developed based on a detailed review of innovation models and case studies worldwide to ensure research delivers impactful results for the industry. The model was initially introduced in 2021 and the methodology has since been refined based on feedback (see Figure 19). It recommended that:

- A steering committee is formed rather than a management committee
- The number of RDCs for a pilot is ideally two to three
- Problems could either be a new one sourced from consumer/societal trends, industry, or venture capital theses, or a failed one using traditional methodologies
- Market risk should be the main focus, so choose solutions with lower technical risks.

Note that the model is yet to be piloted in a program from end to end.



Figure 19. The Open Innovation Model.

Australian Eggs

Australian Eggs have developed a **Research Project Extension Plan** to guide the research managers through the process of effectively transforming research outcomes into engaging outputs and communicating back to targeted end-users. The plan should be drafted at the beginning of the project and refined throughout the project’s lifetime. Output ideas for different types of research and available Australian Eggs channels were listed and provided to research managers as a reference. The process of developing the extension plan for a project includes:

1. Identify targeted audiences, project outcomes, and research type
2. Assess the opportunities for developing outputs
3. Identify 2-3 outputs that would be most effective and also suit different platforms, channels and end-user learning styles.

4. Create an output timeline
5. Identify the role of the researcher in producing the outputs
6. Estimate the cost of each output
7. Develop a communications strategy for the outputs (e.g., when and where the output will be communicated).

CRDC

A **Program-level Adoption Pathway** was developed to guide the research projects through the process of considering the opportunities to increase awareness, understanding and behaviour change while it's underway. Within each program area, the adoption pathway development process involves six steps:

1. Define the problems and controversies in each production area that are the **focus of change**.
2. Identify the technologies that extension programs can be built around as well as provide a gap analysis of opportunities.
3. Consider the stage of development of the technology – looking into potentials to engage other stakeholders and end-users.
4. Work through the CottonInfo extension planning framework for the issue being researched. This framework defines the problem or opportunity being addressed, defines current poor management and good management to identify the potential for change, considers what we know about the distribution curve from poor to good management to identify the potential target audience, defines the indicators and metrics that describe the issue and does a service scan to understand who else is working in this space. This provides a foundation to inform activity planning, including the use of the most appropriate extension model (communication/awareness, group facilitation, technology development, program learning, personal consulting).
5. Consider the level of skills acquisition – this will decide the scale of engagement (from general to specific).
6. Identify adoption characteristics of the technology being researched as they can be both motivations and barriers to change.

The extension planning framework includes the following questions.

- What is the problem/opportunity being addressed?
- Can we describe the range of practice from poor management to good management?
- Poor Management:
- Good Management:
- What do we know about the distribution of current management?
- What are the indicators and metrics of the practice?
- Service scan: who else works in this space?

The adoption characteristics include the following:

- Complexity: the more complex an innovation, the greater the resistance to adoption. Complexity requires more understanding and management skill. This increases the risk of successful adoption.
- Divisibility into manageable parts: Divisibility allows for partial adoption, which allows some practice change without total commitment to a technology. Some technologies, like a centre pivot irrigator, are not divisible and require a full commitment up front.

- Compatibility with farm and personal objectives: Farmers have personal needs, such as education of children; that will conflict with farm investment needs at certain times.
- Flexibility: Technology or management practices that reduce the flexibility to respond to context changes such as commodity prices and climate forecasts will be resisted. In a volatile environment, flexibility is a good system feature.
- Profitability: Perceptions of profitability are influenced by the data source (research stations vs real farms), the knowledge that new technologies usually have a lag phase before they pick up and issues of cash flow.
- Capital outlay: This decision will be influenced by the existing debt structure of the business, the risk perception and subsequent cost of borrowing imposed by banks, as well as the farmers attitude to risk and debt.
- Learning required: This is an intellectual cost of time and effort required to learn how to use a new technology. The size of this cost depends on the existing knowledge and experience of the farmer as well as their ability to learn.
- Risk and uncertainty: There is risk in as yet unproven claims of technology and the ability of the farmer to make the technology work in their own environment. As systems are pushed to maximise productivity, they often become riskier to operate, like a high performance car.
- Conflicting information: Nearly all information is translated by actors in a network to suit their own purposes. If information on a technology is conflicting, particularly if it is coming from trusted sources, farmers will be less likely to adopt a technology.
- Perception of the problem: is this really serious for me, the community or my industry?
- Physical infrastructure: Can you buy what you need for the technology and are the physical resources available to make it work? Is there a service industry to fix this thing for me if it breaks down?
- Social infrastructure: Are the social networks in place to provide knowledge and support? What are your physical neighbours doing, and what are the farmers you identify with doing?

The adoption pathway milestones are as follows:

- What level of engagement, with who (target audience) and in partnership with?
- Do we understand the current scope and distribution of practice?
- Are there potential barriers to adoption that could be considered during the project?
- What level(s) of skill are we targeting to get adoption of this technology?

Dairy Australia

The Dairy Australia **Product & Services Lifecycle** is developed to provide a clear and consistent process across the business for the prioritisation, development, management and delivery of projects and services (see Figure 21). The approach aims to facilitate increased usability and impact on end-users and/or taxpayers.

All phases include consultation/collaboration with relevant stakeholders (both internal and external). In particular, the execution phase will involve multiple internal workstreams (R, D, E, Comms, IT etc.). The project team will consist of a range of people from across the business.

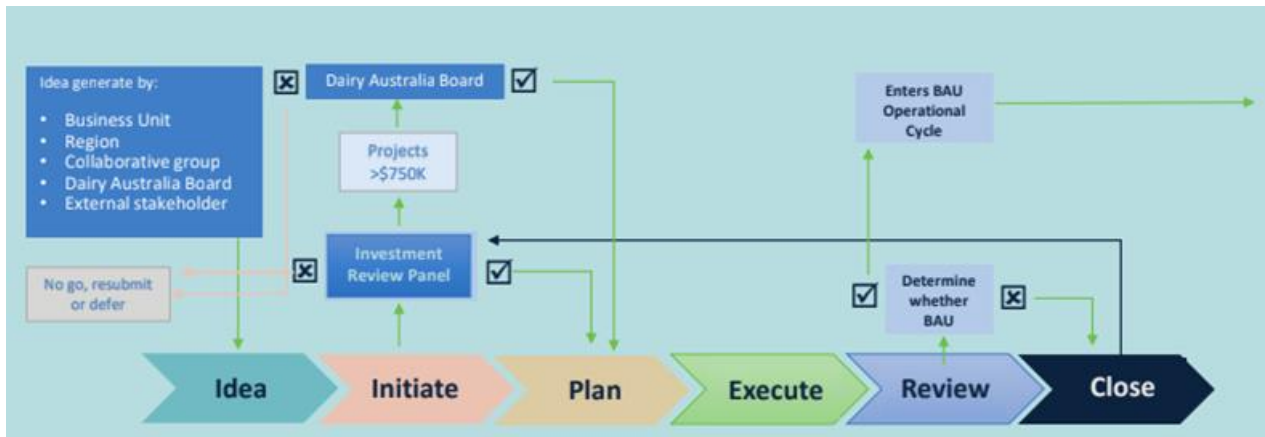


Figure 20. How the Product and Services Lifecycle works.

The **development-led innovation model** (see Figure 21) aims to design/identify the best “route to change” to enable wider uptake of the new technologies. This approach deliberately includes the development phase for projects, linking directly with extension.

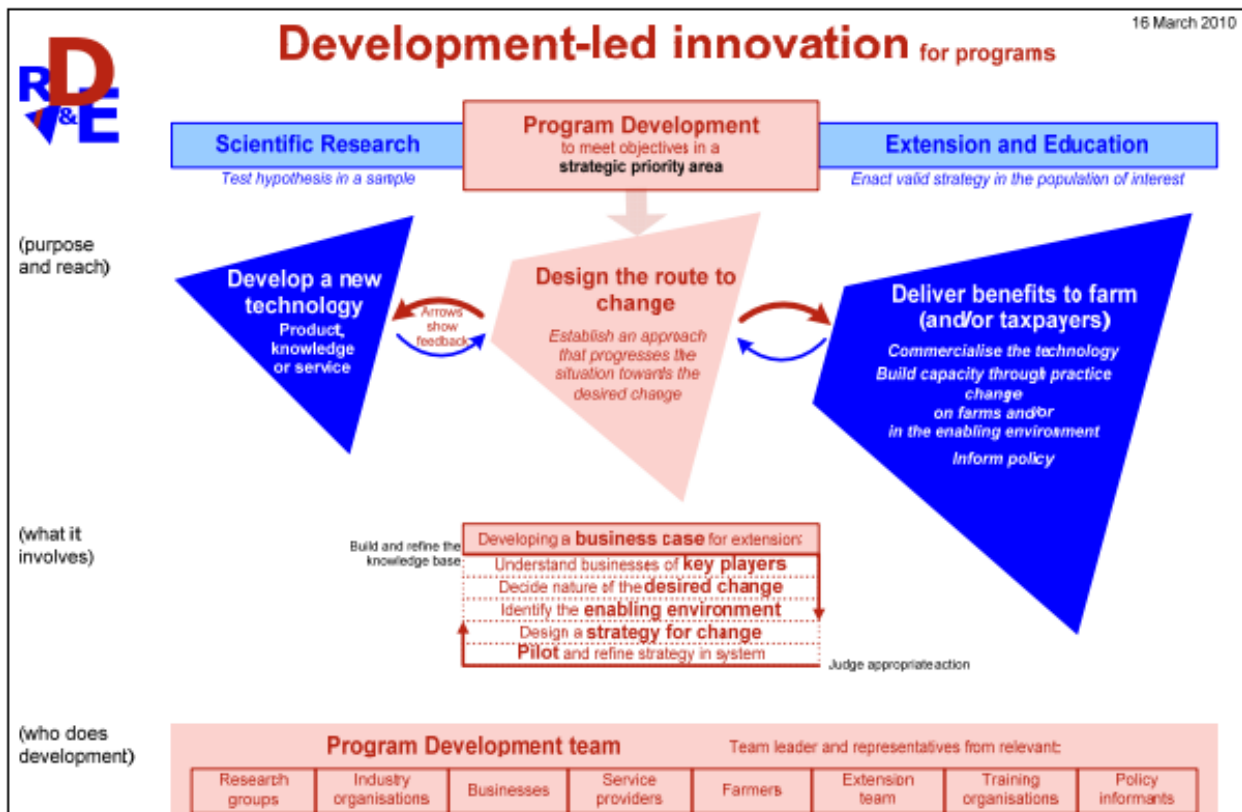


Figure 21. Development-led innovation approach.

Adding program development to link research and extension helps align the activities with the intention and worldview of farmers. Following the model encourages researchers to consider more about the practical aspects of applying the new technology on farms. Establish an effective program development team consisting of personnel from all relevant stakeholder groups (e.g., industry bodies, businesses interested in the technology, research groups, service providers, the extension team, farmers) to provide a formal forum of interaction and enable collective action between organisations.

A business case should be developed for education and extension activities, which involves:

- growing a knowledge-base of the domain to provide appropriate and rich ideas

- deciding the desired change so that stakeholders to communicate back to end-users
- studying the enabling environment in terms of what is needed
- designing a route of change that aims for simplicity in implementation
- piloting the design in the real world and refining the approach.

FRDC

A **National Fisheries and Aquaculture Extension and Adoption Strategy** was developed by a working group made up of extension specialists, industry, fisheries managers and lead researchers. It outlined five key principles for Extension and Adoption, which FRDC has adopted to encourage and promote extension and adoption:

- All stakeholders value extension and adoption activities in the same way as research activities.
- Extension will be a key focus in research project development.
- Project knowledge and outputs are actively managed.
- The effectiveness and impact of project extension activities are evaluated.
- Extension and adoption capacity is maximised and built upon.

FRDC also requires an Extension and Adoption Plan to be developed and submitted for every project. This requires project managers to think about how the project outputs will be used and adopted by end-users when developing the application. A template is developed as part of the National Extension and Adoption Framework to assist researchers in the planning of the Extension and Adoption strategy for their project, including sections such as:

- Objectives
- Target audience/s
- Key message/s – write 3-4 short statements that represent the key messages you want to communicate to the target audiences.
- Methods – identify the methods by which you are going to deliver the information to the target audiences during and after the project.
- Action plan – identify method, timeline, and who will be responsible for the implementation
- During the project – highlight key milestones, timing and audience
- After the project – outlines any work that needs to be done following completion of the core project component. This includes articles, presentations to fisheries managers etc
- Evaluation – identify how you will evaluate the success of the plan (e.g., use targets).

Hort Innovation

Hort Innovation has launched a new **Extension initiative** to ensure communication and extension activities truly support business decisions and enhance practices on farm. The extension initiative enhances the coordination, communication and application of research and development outcomes and includes a team of **Regional Extension Managers** who work in the regions. These managers play a linking role and bring broad coalitions together to share skills and capacity, to solve identified regional problems. Service providers benefit from building their technical and extension skills and knowledge via across industry networks. Collaborative approaches to solving regional problems enable tangible outcomes for growers to use on farm.

Regional Extension Managers operate in six horticulture regions that have been identified for targeted extension, capturing 94% of horticultural activity in Australia by employment and production value.

LiveCrop

The **RD&E Blueprint** was developed after extensive consultation with exporters and producers in which they identified the most critical priorities for investment. This ensures the industry has a common understanding of the focus areas and keeps the focus on demonstrating how projects contribute to the industry goals. There will be an appetite for the research funded and, ultimately, the adoption of research outcomes.

The **Livestock Export Research and Development Advisory Committee (LERDAC)** provides strategic research advice, represents industry priorities and reflects community expectations. They will receive updates and reports from the research projects to measure progress against the priorities and assess if the objectives are being met.

The **Management Committee** is the decision-making body for the RD&E Program. They oversee the delivery of the Blueprint through proper governance and management of the RD&E Program, including ensuring extension and adoption activities identified for the project are either completed or transferred to or progressed on the appropriate pathway. Their role also ensures stakeholder communication activities on research projects are undertaken.

The Management Committee and LERDAC are committed to ensuring that they continually invest in and manage a balanced portfolio of RD&E projects. As a result, each project will be progressed through a consistent Management Committee led **decision-making process** (see Figure 22), where successful projects progress from ‘concepts’ into viable projects.

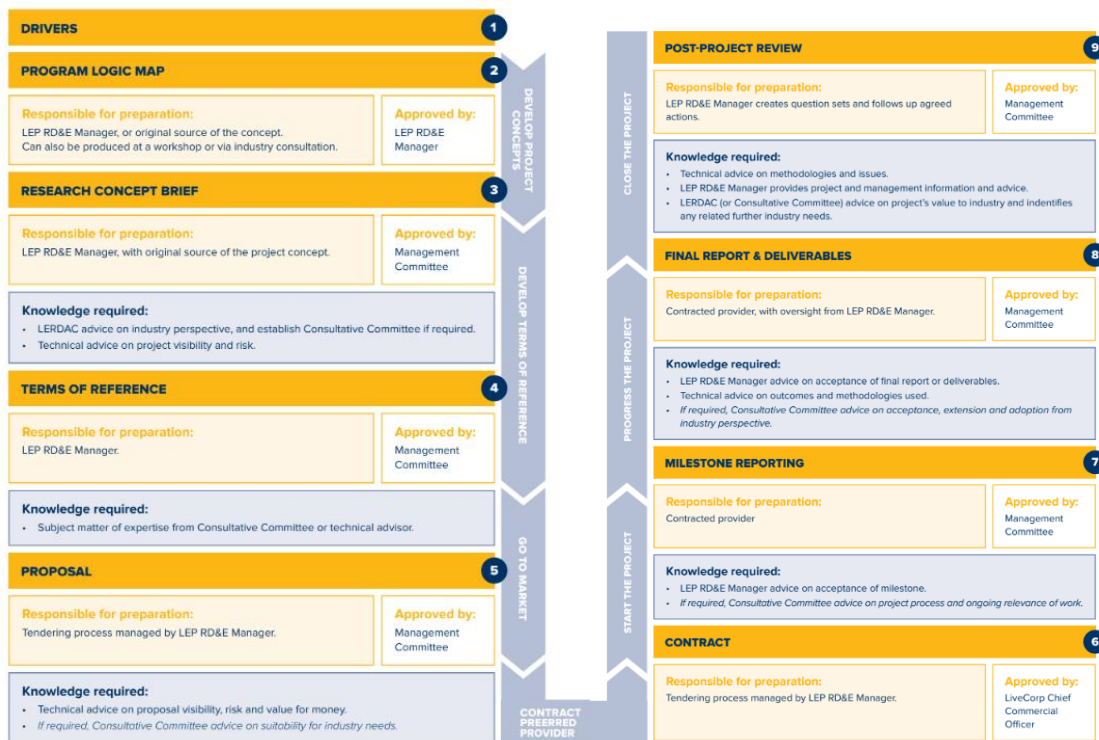


Figure 22. RD& Program Operational flow.

NSW DPI

NSW DPI researchers rely on external funding for their projects, so the assessment criteria and the adoption expectations/plan will be **dependent on the requirements of the external funding body**. NSW DPI has their own internal project **proposal process** that is heavily weighted towards documenting budgetary/resource requirements and how much will be co-contributing relative to the external collaborator. A draft adoption plan checklist for internal use was developed based on Roger’s ‘Diffusion of innovation model’ (see Figure 23).

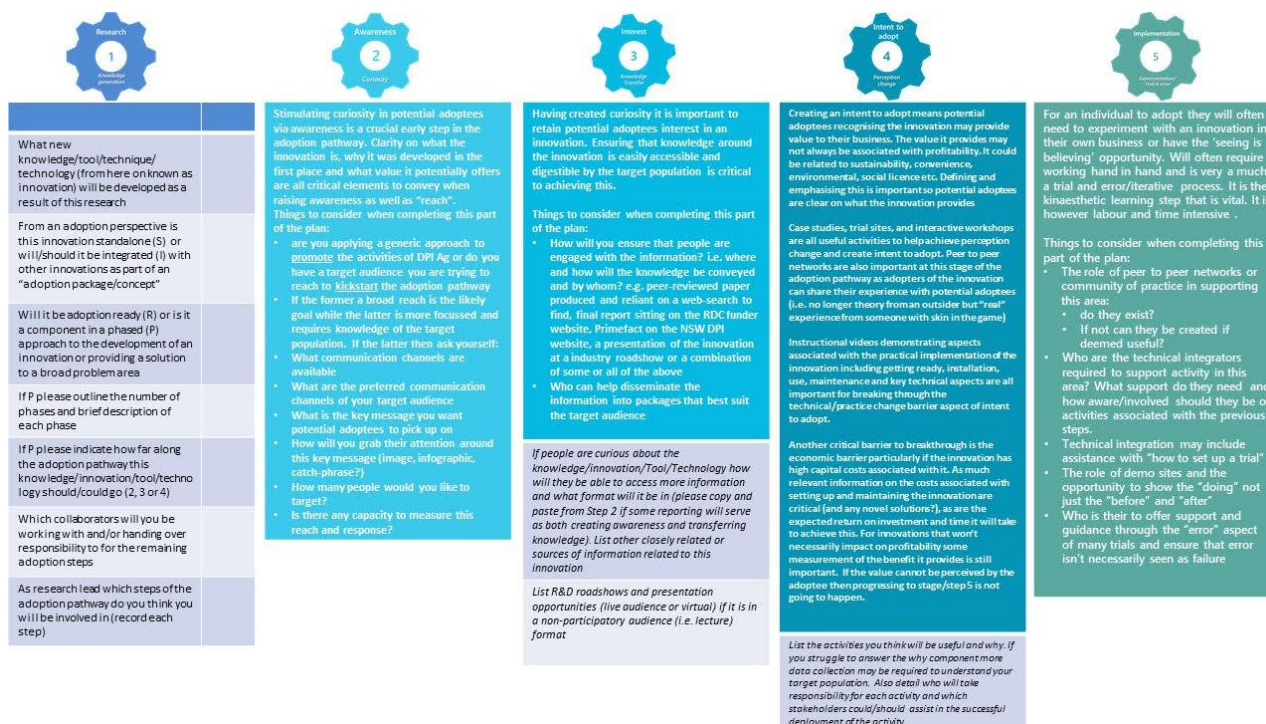


Figure 23. Adoption plan checklist.

Wine Australia

There is no one specific 'preferred' adoption pathway at Wine Australia as it needs to be fit for purpose. An **Extension and Adoption Strategy** informed by a review of activities in the sector was developed and supported by a list of principles and an Adoption Pathway Checklist. The strategy advises the development of the research projects and guides the investment in extension and adoption activities. The six principles include:

- Design activities in conjunction with users
- Offer consistent messaging
- Measure impacts
- Support multiple providers and a range of access points
- Focus on outcomes
- Encourage and create innovation loops – not linear paths.

Depending on the project objectives, **different approaches** are being used to tackle extension and adoption, for example:

- **AgriFutures open innovation model** is used to attempt to build adoption pathways with impact projects. AgriFutures report authors were engaged in the process to offer coaching and support.
- **Align with the KPIs in Wine Australia’s Strategic Plan** if the project has targeted adoption group
- **Specialised consultants** are engaged in identifying the commercialisation pathway that is most suitable for specific research outcomes.

Appendix 5b: Proposed templates

Project proposal template

Components	Descriptions
General/administrative details	Funding applied for, organisation, contacts, etc
Project details	
Project summary	For publication purpose
Confidential project summary (if required)	
Research background	The researcher's understanding of past research in this field
Project objectives	<ul style="list-style-type: none"> • What opportunities/problems that this project will address • Which of these objectives are linked to the RDC's strategic plan/R&D objectives
Project outcomes and benefits for the industry	What impact will the project have on the industry? This should be across the economic, environmental, and wellbeing areas.
Target audience and change <input type="checkbox"/> Awareness <input type="checkbox"/> Knowledge <input type="checkbox"/> Skill <input type="checkbox"/> Motivation <input type="checkbox"/> Confidence <input type="checkbox"/> Practice change <input type="checkbox"/> Community connection <input type="checkbox"/> Other	<ul style="list-style-type: none"> • Define the project's target audiences and their motivations, constraints, preferences, etc • What is the behavioural change that they will need to undertake to be benefited from the project outcomes/ what behaviour change this project will influence (tick the box)?
Plan for extension and adoption of project outcomes	Describe the proposed ' pathway to impact ' – plans and process this project will use to effectively transfer the research/project outcome to on-the-ground actions, including all planned extension/ communication/ commercialisation activities
Detailed project methodology	Include a table outlining what activities the project will undertake to investigate.
Outputs (Deliverables)	What tangible outputs will be produced through the above activities?
Budget	
Project timeline	Consider using ' stop/go ' for each milestone to

	minimise risk.
Draft milestone table	
A detailed budget table	Including the cost of each of the project activities
Cost-effectiveness	Describe how this project is cost-effective
Co-investment/ industry support/ external funding	Include in-kind contributions
Collaborations	
Project team capabilities and experiences	
Industry stakeholders/experts in the field involved in the project	
Target audience involved/represented in the project	Key stakeholders and end-users involved in the project design from the beginning
Related project/dependencies	Including prior projects that this project will build on
Project risk assessment	Define and list what risks may affect the project and the proposed solutions
Monitoring and Evaluation (M&E)	How the project will be assessed/success will be measured?
Compliance & Confidentiality	IP, conflict of interest, etc

Project proposal assessment criteria

Criteria	Score
Impact of the project	
1. How much value do the benefits of this research provide to industry (e.g., the number of people/businesses will be impacted, or the amount of cost will be reduced)?	
2. How feasible will the impact be delivered and transferred to the ground (i.e., will farmers be willing to adopt the product/practice)?	
3. How important/urgent the research is to the industry (e.g., has there already been a demand? What existing issue will it address?)	
Methodology	
4. Do the methods used fit the purpose of the research?	
5. Are the methods easily understood and evaluated?	
6. Do the proposed project personnel have the capability of performing the proposed methods (e.g., is there a statistic analyst if statistical analysis is part of the research)?	
7. Is the timeline feasible, particularly is there consideration for the time taken to undertake each of the following activities? <ul style="list-style-type: none"> • Gain ethics approval • Recruit participants • Collect data • Write reports or develop outputs • Analyse data • Present data • Publish findings 	
Budget	
8. With respect to the scope and methods, is the budget justified?	
9. Is there anything in the methods that haven't been accounted for in the budget?	
10. Does the budget, or components of, indicate a compromise on quality?	
11. Will the project fulfil the research priority, or will additional research investment be required in tandem or later?	
General	
12. How relevant is the project to the research priorities of the RDC?	
13. How capable and experienced are the organisation and principal investigator to carry out the research?	
14. Has sufficient background research on the research topic been conducted?	
15. Is the project a duplication?	

16. Have the researchers engaged with the industry to develop the proposal?	
17. Is there anything within the scope that isn't required?	
18. Are there any elements that aren't in the scope but should be?	
19. Are there any perceived or real conflicts of interest within the proposal?	

Report template

Components	Description
Achievement against milestones	A table outlines the contracted milestone, status (achieved/in progress/on hold/not started), and explanation (e.g., why and how it can be considered as achieved?).
Outputs produced	A table lists all the outputs produced as well as a brief description (# of newsletters produced on what topics)
Outcomes from project outputs	A table outlines the engagement of each of the above outputs (e.g., # of participants) and its key impact (what have the participants learned or been informed through this output?)
Feedback	Outlines feedback from participants/ stakeholders upon being part of the project (divided into success, challenges, recommendations)
Media/ public summary	A summary uses plain English that is for public release
Technical report	The main body of the research report including sections such as: executive summary, background, lit review, methodology, findings, discussion, limitations, conclusions.
Future research and recommendations	As a result of the research, what the next step should be?

Appendix 5c: Project categories and success factors

The purpose of proposing these frameworks is to differentiate between projects based on the focus and context rather than a single ‘end-point’ of adoption of direct benefits to users. It’s not that the ultimate goal of RD&E is not to benefit end-users/industry/the nation – but each project funded falls within a specific context of its focus, technology, resources, timeframe and where it sits in terms of what has occurred previously and what concurrent projects/activities are occurring.

The first table suggests the different focus areas in which a funded project may fall during one of its phases or its one-off life. This is not meant to be a continuum for an individual project as such. For example, one project may be focused very much on research – and when that is completed, the outputs may be commercialised, fed into other projects and/or be left to communication and market forces to encourage use of new technologies or approaches. In this case, its ‘success factors’ are to ensure that in the process of the research the project team has done what they can to make the outputs as useful or ‘adoptable’ as possible. In doing that, engagement at some level with stakeholders is a critical step in ensuring that this will be achieved.

The table also highlights those factors that provide context for a project – its size, timeframe, need for co-design, complexity and (obvious) value proposition. The full list of these is best captured in the ADOPT program – as it is about the likely ‘adoptability’ given the user context and the technology factors. What ADOPT does not include are factors such as project focus, time and resources available.

Categories of projects and indicators of success

		Indicators of ‘success’ – i.e. increasing useability, adoptability and potential benefits						
		Credibility	Industry support	Co-design	Engagement	Adapting	Adoption	Benefits
Project characteristics		Peers endorse rigour and value/accuracy of research outputs with research showing significant benefits for industry and it meets an expressed or logical need of the industry	Industry organisations and SIP engaged and positive about value and usefulness of research outputs and/or development products	Users/producers involved in design and testing of outputs are positive about their input and the value/usefulness of products	There was a high level of extension engagement with users with positive reactions and measurable gains in KASA	There has been initial trialling and some take up of new information, tools and/or practices with clear momentum and a post-project pathway to adoption	There has been a rapid take-up of information, tools and practices	There is evidence of individual and industry level benefits – production, profitability, environmental and/or social
Focus	%							

Research		XXXX	XXX	XX				
Development		XXX	XXX	XXXX	XX	XX		
Extension/Adoption		XX	XX	XXXX	XXXX	XXX	XXXX	XXXX
Commercialisation		XXXX	XXX	XXX	Commercial responsibility			
Mitigating factors – what can influence the ‘success’ level of a project								
Size (budget, locations)	X	The size of the budget can limit the capacity to engage and achieve the ‘ideal’ level of ‘success’. Small projects will need to consider the most efficient ways to enact the principles - to enable intent. Smaller projects however, within a limited scope and boundary and with sufficient time may well be able to incorporate many of the success factors within the more limited scope.						
Large								
Medium								
Small								
Timeframe	X	As with size, shorter time frames can limit the extent of movement towards the adoption end of a project. How these projects fit within other sequential phases and/or other related projects or programs will affect their contribution and achievement of success.						
Short (1-2 yrs)								
Medium (3-4 yrs)								
Long (5+yrs)								
Following phase								
Co-design Level	A-D	Some projects are able to work with practices and approaches that have already been developed elsewhere and proven to add value and be useful to producers and others. It may be that testing/demonstrating/modifying is needed rather than the full suite of engagement for planning. Stakeholder engagement in extension roll-out would remain important. [See diagram at end of this paper]						
A – checking								
B – adapting								

C – exploring		
D - developing		
Complexity	X	As with Co-design levels A, approaches and practices that are less complex and readily fit into farming systems and culture and may require a less engaged process to ‘roll-out’ successfully. Alternatively, more complex projects will require much more engagement and co-design to successfully integrate into a farming system.
Low		
Medium		
High		
Value proposition	X	A clear high value proposition will make a significant difference to the interest, engagement and potential adoption of an approach or practice. This may be in economic or practical/ease of management sense - and/or might involve the gaining of incentives to support a change.
Low		
Medium		
High		

The challenge is to put appropriate steps into place that assist in achieving ‘success’ (i.e. usefulness and adoptability) given the project context so that it makes the best contribution towards the end game of benefits to the users/industry/nation. The next table starts to suggest some of those steps that could be undertaken to contribute towards these success indicators being achieved. The research currently being undertaken in this project can test and add to these based on what these emerges during the process.

Contributing factors for ‘success’

Credibility	Industry support	Co-design	Engagement	Adapting	Adoption	Benefits
Peers endorse rigour and value/accuracy of research outputs with research showing significant benefits for industry and it meets an expressed or logical need of the industry	Industry organisations and SIP engaged and positive about value and usefulness of research outputs and/or development products	Users/producers involved in design and testing of outputs are positive about their input and the value/usefulness of products	There was a high level of extension engagement with users with positive reactions and measurable gains in KASA	There has been initial trialling by users and some take up of new information, tools and/or practices with clear momentum and a post-project pathway to adoption	There has been a rapid take-up of information, tools and practices	There is evidence of individual and industry level benefits – production, profitability, environmental and/or social
<ul style="list-style-type: none"> • Transparent research process with good scientific method • Plans, process and outputs reviewed by experts outside of project team • Papers and publications detailing references and method • Links clearly to a needs analysis process 	<ul style="list-style-type: none"> • Project clearly aligns with industry priorities • Industry stakeholders kept informed and updated with responses to feedback provided 	<ul style="list-style-type: none"> • Users are explicitly interactively engaged to provide input into design of outputs and/or extension process • Users test and provide feedback at all stages of developing and finalising outputs • Those who provide feedback are themselves given feedback about how their input impacted on final product 	<ul style="list-style-type: none"> • There is a specific communication and engagement plan which allows for 2-way communication • Stakeholders and users provide input into the plans • There is collaboration and coordination with other programs/ organisations delivering in the same area/topics to maximise synergies 	<ul style="list-style-type: none"> • The value proposition is high, clearly articulated, barriers understood and addressed. • The practice(s) is/are easily trialled at a level which can be reversed if needed. • The practice(s) is/are not complex – and/or effort is made to simplify packages and processes to aid in integrating 	<ul style="list-style-type: none"> • The change is relatively easy, fits easily into current farming systems, has a clear value proposition with a quick return/showing of benefits • There are good communication and extension resources spread over the target area • Capacity is built in the target community and the incumbent advisors 	<ul style="list-style-type: none"> • Sufficient time has passed for benefits to be measured – at individual farm and/or industry level • Benchmarking data is readily captured and linked to project activities and outputs • Case study and research results have been able to underpin useful BCAs. • The climate, marketing and cost context has allowed the

		<ul style="list-style-type: none"> • The broader stakeholder/user community is kept abreast of the design and testing process 	<ul style="list-style-type: none"> • Good extension process is used – mix of methods appropriate to project and context • Peer to Peer approaches are used to maximise exposure, sharing and confidence • Demonstrations are used where possible on commercial farms • Real-time evaluation is used to capture reactions and impacts and guide adaptive management 	<p>into current farming systems</p>	<ul style="list-style-type: none"> • Other programs and organisations have included support for the practices in their programs • There has been sufficient time in the project life for the take-up to occur and be observed • There is effective real time evaluation to guide the process. • Case studies are used and circulated showing benefits to respected peers 	<p>practice to continue and to provide the expected benefits.</p>
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Co-design logic

There is a lot being said around the importance of co-design – including users in the design and testing phase of new technologies, practices or approaches – to ensure it is grounded in user needs and conditions and so is useful and adoptable. While this is acknowledged as a principle, some projects have a focus where they are tasked with extending technologies, practices or approaches that have been developed previously, are ‘required’ by regulation (e.g. water quality practices) and/or already have a history of being used elsewhere. In this case, it is not appropriate to go into a deep ‘basic’ co-design activity with users. As the table suggests, it may be that such a product easily slips into the new situation, or it may need to be modified, trialled or demonstrated as a fit for the new situation. Likewise, when there is no clear technology/approach/practice to ‘extend’ as such, then working at an exploratory level and development of co-design might well be needed. The point is that we need to use a utility and practical lens when we talk about co-design.

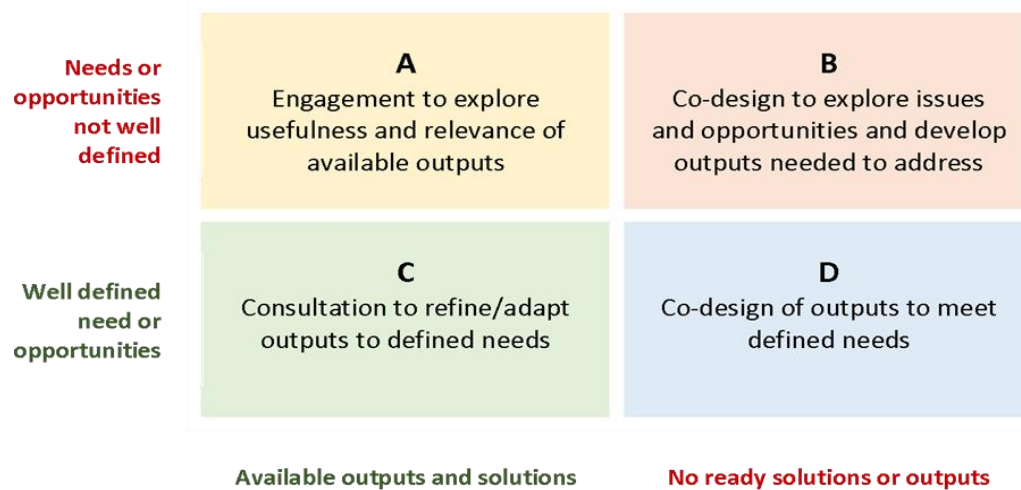


Figure 24. Determining the level of co-design needed for research and development ‘products’.

Appendix 6: Cross-RDC online survey

This report presents an analysis of a survey undertaken to investigate ways to better integrate extension into research projects, so as to enable greater end-user change. It is part of the project *HA21001 Designing the integration of extension into research projects*, which is co-funded by Hort Innovation, Cotton Research and Development Corporation, Wine Australia, Fisheries Research and Development Corporation, Dairy Australia, Australian Eggs, AgriFutures, LiveCorp, and NSW Department of Primary Industries. The survey was distributed through key contacts in each of the Rural Research and Development Corporations (RDCs) and was open from 10/3/2022 to 1/4/2022. Spelling mistakes and minor grammatical errors were corrected in the responses, without changing the meaning or intent of the comments.

Summary

Almost half (48%) of the 241 respondents identified as undertaking a research role. Other roles were manager (17%), development (12%), and extension (12%). Responses were received from 14 of the 15 RDCs. The largest number of responses was received from those associated with Hort Innovation (51), followed by CRDC (34), and GRDC (31).

When asked to select the three main factors that help RD&E projects to be widely adopted by industry, almost two-thirds (63%) of the respondents selected 'There are clear benefits (production, profitability, environmental and/or social)' as the reason that RD&E projects have been widely adopted by industry. Just over half (54%) selected 'High level of extension engagement and two-way communication with end-users throughout the project', while just under half (47%) selected 'Industry representatives engaged throughout project' and 'The change is relatively easy, fits easily into current farming systems, and has a clear value proposition with quick benefits'.

There were many additional suggestions provided by 62 respondents. Several of these related to appropriate engagement activities (11) with comments such as 'Industry representatives engaged before the commencement of the project', and 'Stakeholders engaged extensively and throughout the research'. Others suggested effective communication (7) with comments such as 'Clear communication and engagement with end-users of science to enable good uptake of research'. Another suggestion was to involve well-known, respected people (4) with comments such as 'The most important factor in adoption is getting support from influential industry players and have them adopt the tech. One influential producer can be more value than several grower meetings'.

When asked to select the three main reasons for less-than-optimal adoption of research results, just over half (52%) of the respondents selected 'Perceived low value proposition for end-users to change their practices' as the reason for less-than-optimal adoption. This was closely followed by 'Changes required of end-users is too complex and not easily trialled' (49%) and 'Insufficient involvement of end-users during the project' (45%).

There were many additional suggestions provided by 80 respondents. Several mentioned timeframes (9) and included comments such as 'The best uptake that I have seen is from longer fully completed projects that have producer engagement, not where solutions are hurried and not complete or economic benefits have not been fully explored' and 'Research projects of 1/2/3 years - often the output is only ready at the end, need to design projects to include an adoption phase; not have it post project'. Others mentioned lack of suitable engagement (8) and included comments such as 'lack of engagement with end-users in project development is a key issue, but this is driven by the loss of regional RDE staff across Australia and the shift to large city-based institutes. The result is that the researchers writing the proposals aren't embedded enough in the systems they are researching to fully understand what is needed by way of a viable solution that growers will take up'. The lack of extension expertise (5) was also mentioned, with comments such as 'Development and extension is not included in the initial planning of the research and it is thought that it will "just happen"', and 'Research team does not have the experience or expertise in transfer of new knowledge to stakeholders'.

When asked 'What's the one thing that RDCs could do differently to ensure better outcomes for their RD&E projects?', there were 212 responses. The following five key themes emerged from the data.

1. Extending the length of projects (n=36)

Many people suggested extending the funding period to five years, so that there is sufficient time to perform both the research and the extension. As stated by one respondent, 'Adopt 5-year research agendas, 2-3 year trial programs are too short to obtain robust results that can be extended. This would allow for better integration of research and extension so messaging is delivered to growers with more rigour in the research.'

The comment was made that if researchers are forced to keep trimming their project budgets, then the outcomes will be sub-optimal. It was also suggested that greater funding would allow greater interdisciplinary work and more extension and engagement activity.

2. Incorporating extension (n=30)

The concept of incorporating extension expertise into RD&E projects from the design phase was also suggested by many respondents. It was stated that it should not be a token gesture, but as one respondent put it 'Ensure every research project has a bona fide extension component (not just ad-hoc communication, e.g. a magazine article, or one-off 10 minute presentation at an industry forum). There is industry engagement at multiple stages throughout the project and a clear strategy to support industry practice change.'

As another respondent stated, 'Include D & E in research projects. Not just words, but actually investing in extension specialists to work with the researchers. Researchers are, for the most part, not social scientists. We can talk with industry, but do not have the time or interest to be all over the key methodology most appropriate to achieve adoption and demonstrate impact/evaluate. I'm not suggesting an extension specialist on every R&D project, but regionally based extension specialists that would work with multiple projects providing this expertise where and when it is required.'

To ensure this happens, another respondent suggested 'Include extension activities as milestones and demonstrate budget allocation to extension activities.' It is acknowledged this will be costly, and as stated by this respondent, 'Stop trying to make quick and cheap adoption solutions from research outcomes. The best adoption processes are created by involvement of the extension staff in the research so they have ownership and then adequately resourcing their extension work.'

3. Improving stakeholder engagement (n=21)

Engagement is not only important towards the end of the project, but throughout its lifecycle. As one respondent stated 'Engage end-users throughout the entire research project to ensure research has end-user benefit/practicalities considered.' Another commented similarly, saying 'Don't just tack end-user engagement and 'extension' on at the end as integrating end-users early not only builds potential delivery capacity but their input helps to generate more beneficial innovations for end-users - and that's the most fundamental requirement for adoption.' Another said 'Engage with industry throughout the entire process. From concept through to design and trialling.'

4. Using a co-innovation* approach (n=13) *Co-innovation involves key stakeholders (including end-users) from the very beginning of the project when they help better define the problem/opportunity. They then contribute to designing the project and helping create solutions in collaboration with the other project members.

Involving end-users and other stakeholders throughout the project life was highly recommended, and as one respondent said 'Make sure that all stakeholders are engaged in the process, right from establishing research priorities and planning for projects, right through to extension and adoption. The broader the input, the better the results will be.' Another stated that 'The most adopted programmes are those that built relationships with end-users prior to any research starting.' Involving end-users in problem identification was mentioned by this respondent who suggested 'Contract projects that engage with the end-user to identify the problem and work collaboratively towards a solution. This may require different ways of operating for the RDC, as suggested in this response 'Change procurement processes to enable more effective co-design of projects. e.g. have EOI then select 1-2 that have time and guidance to co-design projects involving all collaborators, end-users, other stakeholders (e.g. supply chain, extension deliverers) and funders.'

5. Better understanding the psychological drivers for practice change (n=11)

Better understanding the existing system and the psychological drivers of change will enable greater practice change. As one respondent commented 'Do more high-level adoption studies to understand the drivers of the decision making. For example, CRDC recently funded a study to understand the key drivers of N decision making to help inform future research.' Another said 'Involve social scientists in each project to make sure the barriers to adoption by end-users are better understood and addressed.' This should be done at the beginning of the process, as mentioned in this comment 'Understand the true needs of the end-users before commissioning RD&E projects and ensure end-users and people with extension/adoption expertise are involved from the outset rather than part way or at the end.'

Another respondent commented ‘Pause to listen and understand rather than seek to educate, ask what are primary producers trying to accomplish and help support them. Cognitive empathy is not about warmth and kindness, it's about listening with a curious mind about the deeper level of thinking. If we can understand where grower behaviours and an organisations' capabilities align there is a solution; where we establish a behaviour is not supported, there is an opportunity to explore, one that may not have been considered without the inner voice of the grower trying to accomplish what they are trying to achieve.’

When asked if they would like to be invited to further discuss this topic, 132 of the 230 respondents (58%) indicated that they were willing to be involved through interviews and/or focus groups.

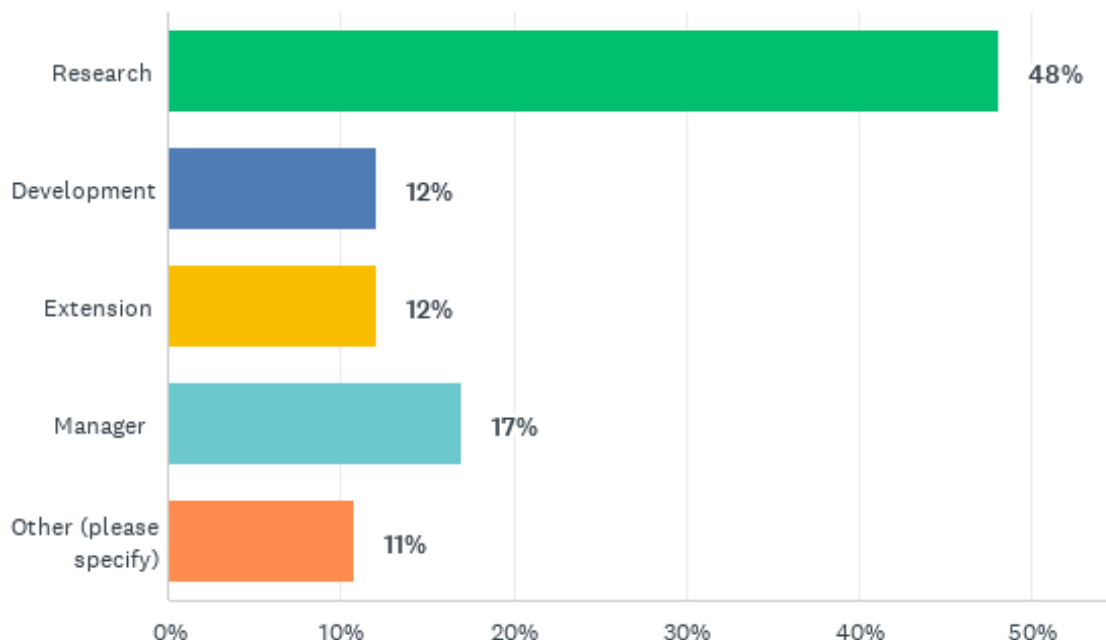
When invited to provide any final comments, several respondents commented that they were pleased to see this project underway, with comments such as ‘This is a really important topic. Thank you very much for leading this, in a pan-RDC manner; visionary and impactful!!!’ and another said ‘I'm glad this project is being funded. It is well overdue.’ The rationale is explained by this respondent: ‘As a researcher I really want to see my work make it all the way through to real world impact - for that to happen I want to be part of the extension. Thanks for the opportunity to comment on this important topic.’

Another respondent reminded us that ‘Adoption is a complex process, differing between farming enterprises. A tailored approach is needed. Local relevance is important.’ Another respondent provided this quote ‘With an empathetic mindset you let go of that need to change others or to demonstrate your competence. Instead, you listen for the deeper reasoning and philosophies within other people. Together you can explore deeper currents and work out better solutions (Young, 2015).’

Results

Q1. What is your primary role?

Almost half (48%) of the 241 respondents identified as undertaking a research role. Other roles were manager (17%), development (12%), and extension (12%). Those who selected 'other' included those who indicated their roles as a mixture of RD&E (4), education (3), consultant (2), and policy (2).



ANSWER CHOICES	RESPONSES	
Research	48%	116
Development	12%	29
Extension	12%	29
Manager	17%	41
Other (please specify)	11%	26
TOTAL		241

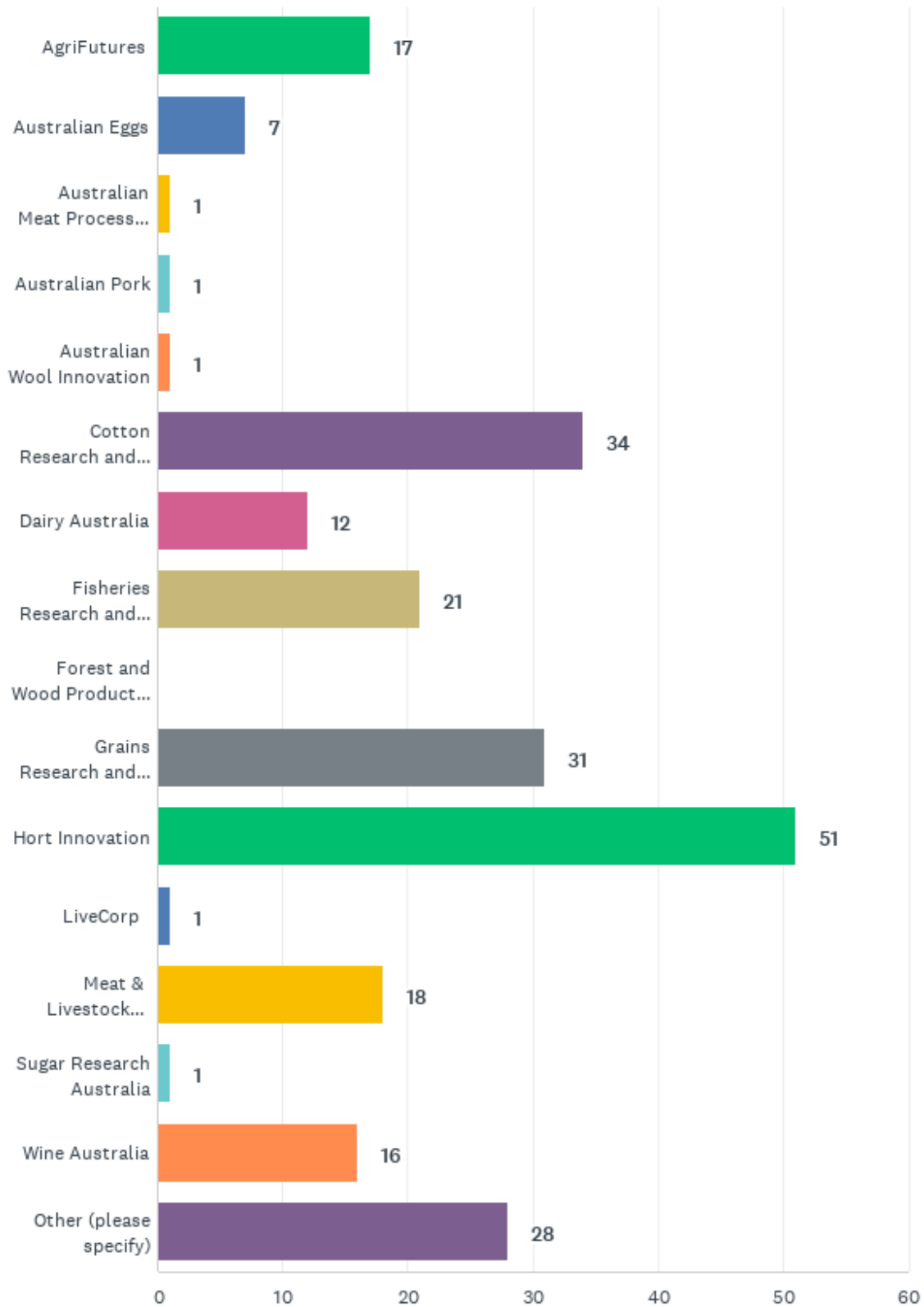
Other responses

- A combination of research and extension
- Accountant
- Administration
- Combination of leading and directing RD&E projects
- Communications
- Consultant
- Consultant
- Coordinator, comms and extension advice

- Development and extension
- Economic analysis of research outcomes (investment analysis, gross margins, break evens, CBA etc)
- Education
- Education
- Education
- Evaluation
- Lecturer
- Managing RDE programs
- Non-executive director
- Policy
- Policy
- Program designer and reviewer
- Program/ project management in RD&E
- Project Manager
- Research & Development
- Research, development education and extension
- Social scientist working in adoption of new practices and social acceptability of practices
- Supporter

Q2. Which RDC (or associated industry) do you mainly work with?

Responses were received from 14 of the 15 RDCs. The largest number of responses was received from those associated with Hort Innovation (51), followed by CRDC (34), and GRDC (31). Those that selected 'other' included those who work across multiple RDCs (12) and NSW DPI (8).



ANSWER CHOICES	RESPONSES	
AgriFutures	7.08%	17
Australian Eggs	2.92%	7
Australian Meat Processor Corporation	0.42%	1
Australian Pork	0.42%	1
Australian Wool Innovation	0.42%	1
Cotton Research and Development Corporation	14.17%	34
Dairy Australia	5.00%	12
Fisheries Research and Development Corporation	8.75%	21
Forest and Wood Products Australia	0.00%	0
Grains Research and Development Corporation	12.92%	31
Hort Innovation	21.25%	51
LiveCorp	0.42%	1
Meat & Livestock Australia	7.50%	18
Sugar Research Australia	0.42%	1
Wine Australia	6.67%	16
Other (please specify)	11.67%	28
TOTAL		240

Other responses

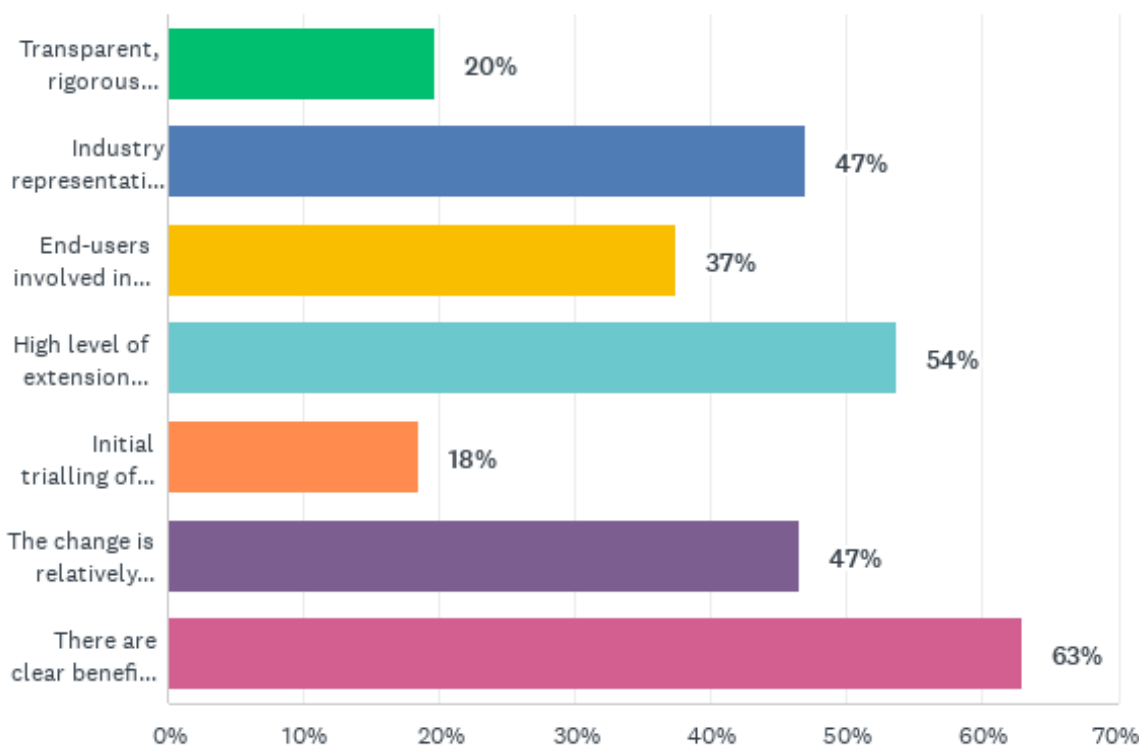
- A number of RDCs
- AgHealth Australia - The University of Sydney
- Consultant. Grains and cotton
- Cotton, red meat, grains, sugar, eggs, horticulture and wine
- CRC NA / GRDC
- CRC Northern Australia
- CRCNA, AgriFutures, Hort Innovation.
- Dept Resources & soon SQ Landscapes
- Digital agriculture and climate so across most/all
- DPI
- DPI NSW
- I work across 7 of these organisations above
- Mix of Dairy Australia, Irrigation, GRDC, MLA
- MLA & GRDC
- Multiples from this list - Cotton, Dairy, Hort Innovation & Wine Australia
- None
- NSW DPI
- NSW DPI
- NSW DPI
- NSW DPI
- NSW DPI

- NSW DPI Agriculture
- NTG R&D
- Protected cropping and dairy
- Retired, both CRDC and GRDC
- Several of these
- Soil CRC
- Various sectors

Q3. Thinking of RD&E projects where the results have been widely adopted by industry, which do you think are the main factors that helped this to happen?

When asked to select the three main factors that help RD&E projects to be widely adopted by industry, almost two-thirds (63%) of the respondents selected ‘There are clear benefits (production, profitability, environmental and/or social)’. Just over half (54%) selected ‘High level of extension engagement and two-way communication with end-users throughout the project’, while just under half (47%) selected ‘Industry representatives engaged throughout project’ and ‘The change is relatively easy, fits easily into current farming systems, and has a clear value proposition with quick benefits’.

There were many additional suggestions provided by 62 respondents. Several of these related to appropriate engagement activities (11) with comments such as ‘Industry representatives engaged before the commencement of the project’, and ‘Stakeholders engaged extensively and throughout the research’. Others suggested effective communication (7) with comments such as ‘Clear communication and engagement with end-users of science to enable good uptake of research’. Another suggestion was to involve well-known, respected people (4) with comments such as ‘The most important factor in adoption is getting support from influential industry players and have them adopt the tech. One influential producer can be more value than several grower meetings’.



ANSWER CHOICES	RESPONSES	
Transparent, rigorous research process	20%	47
Industry representatives engaged throughout project	47%	112
End-users involved in design and testing of outputs	37%	89
High level of extension engagement and two-way communication with end-users throughout the project	54%	128
Initial trialling of results easily undertaken by representative end-users	18%	44
The change is relatively easy, fits easily into current farming systems, and has a clear value proposition with quick benefits	47%	111
There are clear benefits (production, profitability, environmental and/or social)	63%	150
Total Respondents: 238		

Other responses

- Research was done on-farm not a research station.
- All of the above are important, but are all equally worthless because extension is a life-time practice and all projects only run for three years. The fact that extension is now being done on a commodity basis, instead of being based on a whole farm system, also has a deleterious impact on the quality and excess quantity (sifting the grain from the chaff) of information provided put in front of growers - who are now mostly turned off because of the 'noise' out there.
- Making system easy to access through development of APIs and freely available.
- Research targeted appropriately for problem. Stakeholders engaged extensively and throughout the research. Where voluntary uptake does not progress to widespread adoption due to entrenched perspectives, regulating/mandating change necessary which can lead to new mindsets about old practices.
- Work is in plain English with diminished 'process' and willingness of researchers to engage and potentially be proven wrong.
- Starting with the industry issue (or want) that needs to be addressed and then identifying the best collaborators and technologies to address it (not the other way round i.e., building a project around a specific tech or a platform or a provider).
- Encouraged flow from industry need to appropriate RD& E to development of a commercial output.
- Outputs have to work (not just promised), they have to exceed current commercial practice, be easily accessible, interpretable, focused, practical and affordable.
- Change of legislation.
- Time. Program/ project allows for extension of research AFTER research is completed and farmers have confidence the research is at completion.
- Having development resources (people, funding and time) devoted to the development of clear key messages and extension materials.
- High level extension and development resources engaged throughout the project with two-way communication with end-users.
- I think our success was due (not necessarily on order): (1) multi-pronged approach with RD&E. E was imbedded into one project a second project involved on-ground works. (2) seed industry and agronomists working together with us, i.e., we were all promoting common message. (3) There was genuine interest by producers (we were addressing a real need) (4) weather supported establishment.
- Social science expertise, including engagement and extension, is integrated in the project design. And a budget for uptake and adoption is included. Also - the items listed overlap considerably making it difficult to answer accurately.
- Interactive engagement between the funding bodies and the research teams.
- A government willing to enforce change if it provides benefit.

- Alternatives are either limited or expensive.
- As a researcher and grower: where the adoption meets the needs of a grower's purpose. It is my view that the reasons for adoption relate to understanding what a grower is trying to accomplish that is matched by the capability of the organisation servicing the industry. Research is the conduit in the knowledge space between both grower and organisation. My research project involves cognitive empathy (listening sessions where we understand at a deeper level what the problems a grower is facing that we/technology can help them solve). It is only at this level where we fully understand the reasons for adoption. A person's purpose can be achieved using a variety of solutions - manual tools, social tools, mechanical tools and digital tools. This cannot be achieved by surveys or interviews. It can be achieved through deep listening sessions with growers/primary producers.
- Clear communication and engagement with end-users of science to enable good uptake of research.
- <https://adopt.csiro.au/>
- Local support available to assist growers overcome the adoption barriers.
- Normally the researcher knows their work and they can better extend than the extension officers.
- Industry reps engaged throughout project, high-level extension/support from CRDC and CottonInfo teams.
- Need sufficient time as part of contract once research has finished to implement.
- A clear value proposition and defined path to market from the onset.
- Making it easy for farmers to adopt- work on implementing and ensuring it is fit for purpose.
- Industry representatives engaged before the commencement of the project with a clear sense of the need and clarification of 'the problem we're trying to solve'.
- Respected peers champion, or adopt and advocate to others.
- Clear demonstration/communication of how the research outcomes will make grower's enterprises more profitable!
- Involvement in the project of both research and extension specialists - working together with industry in a participatory fashion. Required adequate resourcing to maintain the RD&E team, and regular contact with the target audience.
- Personality of the researcher.
- The research idea was initiated from grass roots/end-users (i.e., farmers), so bottom up not top down.
- Energetic, committed RDE sector or grower proponents at relevant local practical level.
- One or more PESTLE (political, environmental, technological legislative and economic (market) factors present.
- Ensuring results are integrated into consolidated practical recommendations where possible (e.g., ongoing nutrient BMPs, irrigation BMPs etc) so growers and advisors have clear information in a single location that is kept up to date beyond the life of any single project. Extension doesn't have to occur during the project, and often this is a waste of time/resources as results and recommendations are not finalised.
- End-user involvement in design and testing of outputs is also important.
- Environmental benefits.
- Belief and success consciousness (no poverty consciousness).
- Research conducted by acknowledged researchers and outputs that are peer reviewed results that are credible.
- Producers often struggle to see the fit and the value so commercial examples have greatest potential to improve adoption.
- Accessibility and trust. Building relationships with end-users in the planning and in developing the questions that are to be addressed, so as to provide a 'local' solution with the stakeholders.
- Where the problem or issue is clearly defined within the operating context of the farming system and then translated back to a research or innovation need. Solutions then considered with a lens of adoption scale, target audience and likely adoption pathways considered. Demonstrated outcomes that show a profitability, production or sustainability gain provided.
- High level of commercialisation partner engagement with transparent two-way communication throughout the project.
- Having extension staff involved throughout research, but after the research component of the project has finished.
- Extension activities utilised the industries key stakeholders to ensure it was adopted. It did not just make a recommendation, it actually showed integration into the production system and so growers could adopt it. There were not gaps - it showed growers how and where they could access people to help with the implementation.
- Enough drivers in place - e.g., market demand, affordable-financial position enables.
- All of the above is ideal. However, if we are looking at multi-disciplinary or complex research or that which does not provide clear and immediate benefits then consistency of messaging, supported by contextual evidence over period

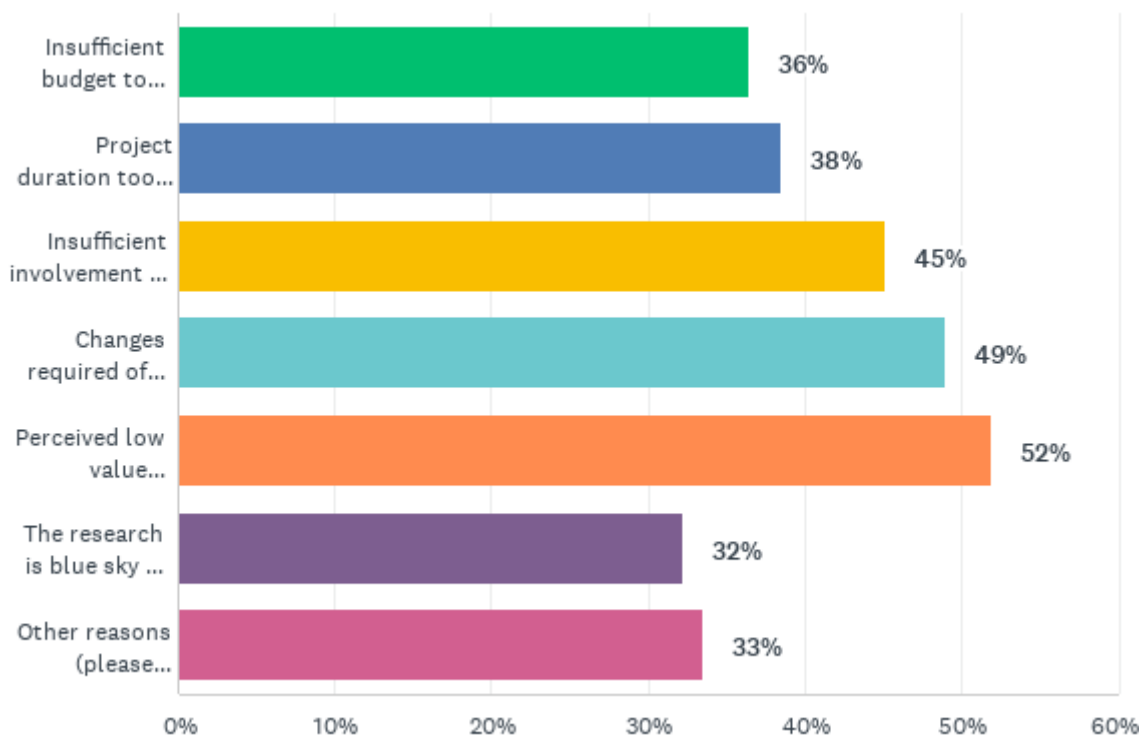
often longer than traditional research project duration. Many examples of these, where extension effort & technical support continues beyond research component.

- Researchers with strong industry background.
- Delivering workshops focussing on project outcomes with interactive field demonstrations.
- Development and regular updating of best practice management guidelines for easy reference by end-users.
- Private enterprises not contradicting outcomes.
- Economic viability (i.e., farmers can afford it) and integration of commercialisation pathways remain a focus of the project. Doesn't necessarily have to have quick benefits because farmers are often planning long-term.
- Significant (numerous) engaging extension activities undertaken by project staff.
- The third clear pillar is that adoption can occur with low risk, if there are added risks (either real or perceived) to obtaining additional benefits, there will be low adoption.
- Undertaken by well-known organizations.
- The extension officers are part of the research team without premature distribution of the results.
- Clear independence of the research and extension staff from businesses trying to make a profit from the research.
- Development personnel and demonstration site funded within a project. Growers involved in the demo and research steering.
- It's about ensuring priorities of the intended adoption are visualized as being greater than the other 100 priorities the individual growers may have. How to do this is to ensure the project holds clear relevance to the industry. Ideally holding good environmental and economic value, easily applied and shows benefits in productivity.
- Embedding a pre-adoption component into the research project is essential to identify and early the enablers and constraints to the adoption of the new technology or practice. Informs the development of extension activities to meet the needs of the end-users (and their service providers) in building their knowledge base, skills and confidence to trial the new technology/practice. More difficult is when the benefits are not clear, change is not simple and trialling is difficult e.g., carbon mitigation.
- All of the above apply - very difficult to separate as it depends on the project which is most important.
- While researchers have a great appreciation for how outcomes from their work may assist the industry, take up by industry is often beyond the researcher's line of accountability. Researchers are not extension specialists. If industry wants to bring about practice change, then a dedicated program is required to do that.
- Scientific rigour and trusted independent (non-commercial) agencies conducting the research and delivering the extension.
- There is a clear down side to not adopting i.e. a policy or regulatory framework which provides a 'stick' and/or incentive to adopt.
- High level of extension engagement between key extension staff and innovative/change oriented farmers.
- The most important factor in adoption is getting support from influential industry players and have them adopt the tech. One influential producer can be more value than several grower meetings.
- I have not witnessed adoption - rather the opposite.
- Industry need - if the industry wants the outcome.
- There is high demand from industry to address a significant issue.

Q4: On the other hand, what are the main reasons for less-than-optimal adoption of research results?

When asked to select the three main reasons for less-than-optimal adoption of research results, just over half (52%) of the respondents selected ‘Perceived low value proposition for end-users to change their practices’. This was closely followed by ‘Changes required of end-users is too complex and not easily trialled’ (49%) and ‘Insufficient involvement of end-users during the project’ (45%).

There were many additional suggestions provided by 80 respondents. Several mentioned timeframes (9) and included comments such as ‘The best uptake that I have seen is from longer fully completed projects that have producer engagement, not where solutions are hurried and not complete or economic benefits have not been fully explored’ and ‘Research projects of 1/2/3 years - often the output is only ready at the end, need to design projects to include an adoption phase; not have it post project’. Others mentioned lack of suitable engagement (8) and included comments such as ‘lack of engagement with end-users in project development is a key issue, but this is driven by the loss of regional RDE staff across Australia and the shift to large city-based institutes. The result is that the researchers writing the proposals aren’t embedded enough in the systems they are researching to fully understand what is needed by way of a viable solution that growers will take up’. The lack of extension expertise (5) was also mentioned, with comments such as ‘Development and extension is not included in the initial planning of the research and it is thought that it will “just happen”’, and ‘Research team does not have the experience or expertise in transfer of new knowledge to stakeholders’.



ANSWER CHOICES	RESPONSES	
Insufficient budget to undertake the desired engagement and communication activities	36%	87
Project duration too short	38%	92
Insufficient involvement of end-users during the project	45%	108
Changes required of end-users is too complex and not easily trialled	49%	117
Perceived low value proposition for end-users to change their practices	52%	124
The research is blue sky or too early in the research for the outputs to be adoptable by end-users	32%	77
Other reasons (please specify)...	33%	80
Total Respondents: 239		

Other responses

- There are many barriers to adoption, lack of awareness or knowledge is however there are many more - often the result of a potential practice change (or adoption of a new tool) does not align with key drivers of the farmer.
- Lack of engagement with end-users in project development is a key issue, but this is driven by the loss of regional RDE staff across Australia and the shift to large city-based institutes. The result is that the researchers writing the proposals aren't embedded enough in the systems they are researching to fully understand what is needed by way of a viable solution that growers will take up. There isn't any collaboration at a funding body level to deal with underlying system resource issues - soils, water, transport, telecommunications - and projects are not regionally applicable, address issues piecemeal, and have too short a time frame - so how can you expect researchers in large institutes with academic careers to be switched on enough to do applicable, long-term work in partnership with growers.
- Insufficient insight/consideration of end-users' current situation / barriers to adoption.
- Extension communication not aligned with end-user needs.
- The innovation is proven in research trials (e.g. yield mapping), however post-project requires off-farm technical support from a commercial provider, however this is not always readily available to keep the momentum going.
- End-users need to be involved in trialling during the project however, often no ongoing support beyond the project to keep expanding this adoption across the farming system.
- No way to capture adoption beyond project timeframe. No ongoing support and facilitation of communities of practice beyond project so becomes stop/start. Time is usually the biggest investment by growers to make changes - is this undervalued in project development?
- Timeframes are too long for the research. Research takes a long time; industry sometimes view this as stagnant and they move on.
- Value proposition not in plain English; research due process is rated / managed more highly than outcomes that 'will make a difference'; outcomes meet subtle as well as overt needs [social].
- Programmatic approaches for funding that foster collaboration (industry, R&D and commercial providers). This will allow the appropriate R&D to be undertaken, whilst in unison develop a commercialization pathway for adoption. This will reduce fragmentation of research, competition, allow for learnings to be further developed, extrapolated to other issues (and industries), allow for the inclusion of additional expertise or methodologies e.g., 'Rural R&D for Profit' model.
- Researchers need commercialization support/ commercial entities need to adhere to some measure of QAing to prevent industry fatigue and disappointment.
- Better quantify impacts of past research projects to identify those approaches/ technologies and contributors etc that have achieved industry adoption and demonstrated impact and those that haven't.
- Tick-a-box rather than targeted extension activities/content.
- Loss of profit (e.g., use of effective BRDs in trawl fisheries perceived to lose product).

- Perceptions that the issue the research addresses is actually a non-issue (e.g. BRD research isn't needed because bycatch isn't an issue)
- Achieving impact is a long-term goal that typically extends beyond the duration of the project.
- Engagement ends at completion of project, provision for ongoing engagement/support after project completes.
- All of the above.
- Development and extension is not included in the initial planning of the research and it is thought that it will "just happen".
- The RD&E pathway/route to market is fragmented.
- Research team does not have the experience or expertise in transfer of new knowledge to stakeholders.
- Same comment as above re: items listed.
- Poor communication between the funding bodies and the research teams.
- Regulators are not interested or able to adopt changes.
- Research projects of 1/2/3 years - often the output is only ready at the end, need to design projects to include an adoption phase. not have it post project.
- Fisheries ministers afraid of decisions. Powerful firms benefit for status quo even though extension would be in the greater good (e.g. quota traders "influencing" ministers to implement unsustainably high TACS to temporarily ramp up quota prices although with long term collapse).
- As per above notes, at a deeper level principles and reasons guide people's actions. When this level of in-depth detail is understood from a grower's inner thinking, transcribed verbatim, and the data synthesised patterns become apparent in the development of maps and diagrams. It is the maps and diagrams that provide longevity to the research because people's reasoning around a higher purpose and purpose itself does not change over time, even though support services and technology do.
- Universities may need to offer actual (cash) investment rather than rely on their "in-kind" contribution to RDE projects. "In-kind" usually means academic researchers are not directly funded to perform the research and instead they must find the time by reducing commitments to other research projects because the university is not backfilling their usual work tasks (e.g., teaching).
- Publications to consider...
 - Rogers, EM 1962, Diffusion of innovations, 5th ed. edn, Free Press, New York.
 - Davis, FD 1986, 'A technology acceptance model for empirically testing new enduser information systems: theory and results', Massachusetts Institute of Technology.
 - Davis, FD 1989, 'Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology', MIS Quarterly, vol. 13, no. 3, pp. 319-40.
 - Lundblad, JP 2003, 'A review and critique of Rogers' diffusion of innovation theory as it applies to organizations', Organization Development Journal, vol. 21, no. 4, p. 50.
 - Tolba, AH & Mourad, M 2011, 'Individual and cultural factors affecting diffusion of innovation', Journal of International Business and Cultural Studies, vol. 5, p. 1.
 - Venkatesh, V & Bala, H 2008, 'Technology acceptance model 3 and a research agenda on interventions', Decision sciences, vol. 39, no. 2, pp. 273-315.
 - Venkatesh, V, Thong, JYL & Xu, X 2012, 'Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology', MIS Quarterly, vol. 36, no. 1, pp. 157-78.
 - Venkatesh, V, Morris, MG, Davis, GB & Davis, FD 2003, 'User acceptance of information technology: Toward a unified view', MIS Quarterly, vol. 27, no. 3.
- Lack of RDC support to undertake study tours using levy funds.
- Normally fruit production research need long time to come to conclusion specially the perennial crops.
- Perceived low value proposition.
- Researchers need more support to develop their business and extension skills.
- No clear or easy way of adopting practice or research into current operating practice.
- Relying on researchers to do the extension. This isn't always playing to their strengths.
- Research projects should not proceed without as least a draft pathway to adoption, this may be incorporated in the project or be contracted as an add on after but forethought to adoption leads to the best results.
- End-users aim for short term gain over long term stability.

- The original concept was flawed due to lack of "open and transparent" debate, project chosen due to grower organisation political or pet project, not enough input from on-ground R&D officers, often high-level management with poor technical knowledge have input rather than on-ground technical R&D people.
- Often you just don't know what the level of adoption has been. The R, D and E project finishes well before it is likely to actually see practice change - not because there is anything wrong with the outputs, but because there is a disconnect between the funding model and the way industry adopts. Also, rarely investment to support an iterative process where industry trials outputs and provides feedback to researchers who then revise recommendations (probably just describing a participatory project...).
- The solution must be created from the problem to be addressed. Too often we come up with new technology or research and then try to fit it into solving a problem that may or may not exist. A good example is the farmer that told his engineer son to invent a system that makes a tractor drive straight. He created Beeline.
- End-users need to see how the research may help them. It needs to be affordable to encourage change. Seeing is believing! Can they see it for themselves on neighbouring farms or at field days etc. Good extensionists to help connect them to the research and help they need along the way.
- End-users were not involved with project design- also adoption may be 2 or 3 years after the end of the project.
- Need patience to be ready for when the time is right for an innovation to have the required level of value in an evolving farming system. This may be well after an initial project needs to end so need ongoing capacity (e.g., grower groups/local agronomists and systems researchers) 'at the ready' to identify and pursue windows of opportunity.
- PESTLE (political, environmental, technological legislative and economic (market) factors absent
- Poorly designed research that has no clear research question, no hypothesis, that is poorly designed or executed and results that are not peer reviewed.
- Clearly articulating the value to producers throughout the project is important.
- Often there is too little engagement and involvement of end-users at the start. In addition, to a large extent we've lost government funded extension and research services and what is left, regardless as to whether it is federal or institutional has not picked this up.
- Solutions identified and then trying to find a problem to apply them too!
- The understanding of why business (and people) change. Adoption is embracing change and this requires a risk appetite and culture to embrace. Some changes are also not feasible in every production facility.
- Lack of extension staff. Need a level of trust and experience of staff and not perceived as inexperienced or short term.
- Generally, it is because there are big gaps in the how of the outcome and often not well-defined benefits.
- Majority of end-users ask for change but are not willing to put effort into making the change happen from a monetary perspective and/or logistic unless fully verified by other users and even then, reluctantly.
- Similar to changes required of end-users is too complex and not easily trialled, but quite often research articles/presentations are too wishy washy and do not clearly communicate benefits.
- Other barriers such as not having sufficient business capacity/resources and an inability to convince multiple partners along the value chain to all buy in.
- Industry not engaged.
- All but last 2 points.
- Disconnect between research knowledge and end-user knowledge. For example, emphasis on understanding how to and when to use micro-nutrients when soil pH (acidity) is not understood or managed.
- Insufficient involvement by end-users is a major road block for adoption of research in the Northern Territory.
- Failure to communicate research to industry.
- Very little collaboration with industry partners or it happens too late or contract arrangements prevent uptake.
- Insufficient focus and perceived importance on the actual extension required for implementation.
- Lack of extension staff support to support the adoption needs of individual stakeholders. e.g. each abattoir is different and any innovation would require tailoring for their processing/production systems.
- The practice doesn't fit in with current management/farming systems. Producers are constantly telling us they don't want to do more work. If they can get extra data from a current or similar management task that's a win as then they can make better decisions.
- It is not just engagement and communication activities that need to occur for adoption. Extension officers who have a clear objective of having the farmer's interests foremost are needed. Not necessarily Government - these could be RDC funded positions.

- People don't like change and resist change.
- Insufficient time to fully interrogate the data within the project. In other words, by the time the final analysis of data was complete and key messages extracted, the project was long finished and everyone had moved on to something else.
- Producers perceiving that there is a conflict of interest between the research group and profits being made from the work. Independence is critical and very often over looked by administrators.
- R&D projects are not RD&E projects. They stop at D, and mostly stop at R. This is because R-people aren't E-people, and because project life rarely continues into the E phase.
- Too many times the industry we are focusing on is left out as far as "ownership" of the intended research outcome. We need to involve industry in every step of the way. What researchers believe to be a good idea with quick uptake is usually a bad idea with poor industry uptake. We need to understand what drives industry decision making.
- Development of real-time technologies is time consuming and thus can hold back the adoption of technologies that required real-time inputs to predict future outcomes.
- Time - producers are time poor thus real-time technologies have a vital role to play. Real-time solutions will increase adoption.
- Researchers not interested in adoption but in their career progression.
- Required a 3rd party commercial provider to deliver service - not a value proposition for commercialisation.
- Perhaps a key reason for lack of adoption is a deficiency in the targeting in the first place. In the first instance, what are the issues that are keeping producers awake at night, and what do they see as possible solutions. From there, build research and extension projects to suit the market needs. Further, there is often a mismatch between the scale of research trials and the real world. To bridge that gap, conducting research trials at a larger scale, costs more money.
- Proper pre-project scoping of the problem is important so the research is well targeted.
- If the outcomes involve a high degree of public good i.e. natural resource conservation, and the end-user is not rewarded sufficiently for these outcomes adoption is reduced.
- Treasury budget restrictions - LEC - lack of extension officers directly linked to research outputs. No consistent MER across the life of the project so the ability to pivot and change based on stakeholder/end-user requirements is non-existent. Lack of corporately supported system to house and analyse end-user engagement that can be shared during and post project life so as baseline data captured can be utilised consistently in future with Industry.
- Results are published in journals only and so unavailable to end-users.
- Adoption has not been highly valued by organisation and so not prioritised.
- Extension process/program is driven by top end 'experts' that cannot engage with the farmers, e.g., studied extension specialist with little or no knowledge or understanding of farming practices.
- Lack of on-going support or central organisation where all farmers can obtain high quality advice. The change from DPI to LLS has reduced the knowledge base and capacity of extension staff and their value becomes very individual oriented.
- The potential benefit e.g., productivity increase is not enough to warrant additional investment/time/labour/changed management required.
- Changes recommended were expensive and it was difficult to quantify the economic results of a perceived environmental benefit. Longer term monitoring of economics could provide data on actual economic benefit. Case studies show multiple benefits in the long term.
- All of the above, but critically understanding the target audience, engaging with and actually providing content appropriate for the target audience is the key. Setting realistic targets at the start of the project, properly identifying the stakeholders and ensuring that a comms/extension staff member is involved in developing the comms so that the outputs are specific to the audience.
- Even blue-sky thinking can be valued if people properly communicate the objectives and outcomes where the target audience is NOT growers, but innovators or developers.
- The best uptake that I have seen is from longer fully completed projects that have producer engagement, not where solutions are hurried and not complete or economic benefits have not been fully explored. Also timing of engagement is critical engage too early and growers lose interest. Full engagement is needed near delivery.
- Researchers never had sufficient communications let alone an extension component to the project.
- Focus on outputs (workshops, factsheets etc) instead of practice change.
- Project too long.

Q5. If there was one thing that RDCs could do to ensure better outcomes for their RD&E projects, what would it be?

When asked ‘What’s the one thing that RDCs could do differently to ensure better outcomes for their RD&E projects?’, there were 212 responses. The following five key themes emerged from the data.

1. Extending the length of projects (n=36)

Suggestions included extending the funding period to five years, so that there is sufficient time to perform both the research and the extension. As stated by one respondent, ‘Adopt 5-year research agendas, 2-3 year trial programs are too short to obtain robust results that can be extended. This would allow for better integration of research and extension so messaging is delivered to growers with more rigour in the research.’

The comment was made that if researchers are forced to keep trimming their project budgets, then the outcomes will be sub-optimal. It was also suggested that greater funding would allow greater interdisciplinary work and more extension and engagement activity.

2. Better incorporating extension (n=30)

The concept of incorporating extension expertise into RD&E projects from the design phase was suggested by several respondents. It was stated that it should not be a token gesture, but as one respondent put it ‘Ensure every research project has a bona fide extension component (not just ad-hoc communication, e.g. a magazine article, or one-off 10 minute presentation at an industry forum). There is industry engagement at multiple stages throughout the project and a clear strategy to support industry practice change.’

As another respondent stated, ‘Include D & E in research projects. Not just words, but actually investing in extension specialists to work with the researchers. Researchers are, for the most part, not social scientists. We can talk with industry, but do not have the time or interest to be all over the key methodology most appropriate to achieve adoption and demonstrate impact/evaluate. I'm not suggesting an extension specialist on every R&D project, but regionally based extension specialists that would work with multiple projects providing this expertise where and when it is required.’

To ensure this happens, another respondent suggested ‘Include extension activities as milestones and demonstrate budget allocation to extension activities.’ It is acknowledged this will be costly, and as stated by this respondent, ‘Stop trying to make quick and cheap adoption solutions from research outcomes. The best adoption processes are created by involvement of the extension staff in the research so they have ownership and then adequately resourcing their extension work.’

3. Better engaging stakeholders (n=21)

Engagement is not only important towards the end of the project, but throughout its life. As one respondent stated ‘Engage end-users throughout the entire research project to ensure research has end-user benefit/practicalities considered.’ Another commented similarly, saying ‘Don't just tack end-user engagement and 'extension' on at the end as integrating end-users early not only builds potential delivery capacity but their input helps to generate more beneficial innovations for end-users - and that's the most fundamental requirement for adoption.’ Another said ‘Engage with industry throughout the entire process. From concept through to design and trialling.’

4. Using a co-innovation* approach (n=13) *Co-innovation involves key stakeholders (including end-users) from the very beginning of the project when they help better define the problem/opportunity. They then contribute to designing the project and helping create solutions in collaboration with the other project members.

Involving end-users and other stakeholders throughout the project life was highly recommended, and as one respondent said ‘Make sure that all stakeholders are engaged in the process, right from establishing research priorities and planning for projects, right through to extension and adoption. The broader the input, the better the results will be.’ Another stated that ‘The most adopted programmes are those that built relationships with end-users prior to any research starting.’ Involving end-users in problem identification was mentioned by this respondent who suggested ‘Contract projects that engage with the end-user to identify the problem and work collaboratively towards a solution. This may require different ways of operating for the RDC, as suggested in this response ‘Change procurement processes to enable more effective co-design of projects. e.g. have EOI then

select 1-2 that have time and guidance to co-design projects involving all collaborators, end-users, other stakeholders (e.g. supply chain, extension deliverers) and funders.'

5. Better understanding the psychological drivers for practice change (n=11)

Better understanding the existing system and the psychological drivers of change will enable greater practice change. As one respondent commented 'Do more high-level adoption studies to understand the drivers of the decision making. For example, CRDC recently funded a study to understand the key drivers of N decision making to help inform future research.' Another said 'Involve social scientists in each project to make sure the barriers to adoption by end-users are better understood and addressed.' This should be done at the beginning of the process, as mentioned in this comment 'Understand the true needs of the end-users before commissioning RD&E projects and ensure end-users and people with extension/adoption expertise are involved from the outset rather than part way or at the end.'

Another respondent commented 'Pause to listen and understand rather than seek to educate, ask what are primary producers trying to accomplish and help support them. Cognitive empathy is not about warmth and kindness, it's about listening with a curious mind about the deeper level of thinking. If we can understand where grower behaviours and an organisations' capabilities align there is a solution; where we establish a behaviour is not supported, there is an opportunity to explore, one that may not have been considered without the inner voice of the grower trying to accomplish what they are trying to achieve.'

All responses

- Do more high-level adoption studies to understand the drivers of the decision making. i.e CRDC recently funded a study to understand the key drivers of N decision making to help inform future research.
- On farm trials with farmer engagement.
- Long term - it took 20 years to develop blackleg resistance and breed high erucic oil out of rapeseed and then do the in-field trials to develop the agronomy for the canola industry to take off. If you want to achieve anything, then stop pissing money into the wind on short term objectives, collaborate with other RDEs and start funding whole of systems research to find solutions to move us beyond oil for a start (where is your N fertiliser going to come from, for instance), and then maybe try to close the loop and develop non-acidifying agronomic systems to conserve N (and P). Small minded, and short sighted and self-interested is my take on the whole RDC enterprise after 30 years in agricultural research.
- Change procurement processes to enable more effective co-design of projects e.g., have EOI then select 1-2 that have time and guidance to co-design projects involving all collaborators, end-users, other stakeholders (e.g. supply chain, extension deliverers) and funders.
- Follow up with users to ensure sustained adoption of project outcomes or technology.
- Ensure that project meet the needs of end-users and there is sufficient funding to deliver them.
- Identify MVPs early in project in consultation with potential partners.
- Build capacity to incorporate extension into the design and delivery of projects.
- Be aware that extension and up-scaling is complex, and each project is unique. Blue-sky projects are important, and expectations of and emphasis on adoption should be realistically low. Spade-ready innovation projects are can have higher expectations of and emphasis on adoption, so building in RICH extension activities and budget is more important.
- Continue to engage end-users.
- Support time and \$\$ for researchers to engage in the field with appropriate stakeholders so rapport and trust can be built to find a mutually acceptable solution to issues.
- Clarify between research that is scoped and expected to be extended adoptable, and research that while desperately needed to understand how to help the industry to develop, is pre-extension and adoption phases. Not all research is going to be directly extendable - yet. However, currently RDC's seem to be adopting an indiscriminate approach whereby extension of every research project is expected.
- Consult broadly with end-users; and industry bodies.
- Ensure every research project has a bona fide extension component (not just ad-hoc communication, e.g. a magazine article, or one-off 10 minute presentation at an industry forum). There is industry engagement at multiple stages throughout the project and a clear strategy to support industry practice change.

- Taking the IP (idea) from submissions without funding the work. New ideas are what is needed, but taking the ideas from researchers without funding the work means that researchers need to hide their ideas in submissions that may not be funded as a result and needed work is not done.
- Ensure that extension programs are focused on 'extension' not communication and be outcomes driven not outputs.
- Involve social scientists in each project to make sure the barriers to adoption by end-users are better understood and addressed.
- Better problem structuring so that procurement creates R&D that more attentive to needs and end-users (e.g., development needs, not just generating new knowledge).
- More responsibility for the RDC to do the extension. This is not always the expertise of the researchers and by the nature of their jobs, they must move onto other projects rather than continuing to follow up with extension/adoption when technically from their point of view, the project has 'ended'.
- Make sure the research is addressing a clear gap/need (market failure).
- Engage end-users throughout the entire research project to ensure research has end-user benefit/practicalities considered.
- Move away from the usual suspects to those whose work is grounded in practical on-ground reality [of course a sweeping statement] - remember that this work is based on relatively subtle issues at times - and researchers are often focused on research process than adoption with impacts with the most relevant mindset-based outcomes for 'segmented users'.
- Stability.
- Incorporate extension/communication as an integral milestone of the projects, with a focus on better identifying the needs and motivations of the target audience.
- No, not one thing. This issue requires a number of interacting.
- Commit funding internally to further ensure dissemination and engagement with end-users, in particular where end-users are not growers/farmers (like in the consumer and demand creation area).
- Support for adoption of findings, funding ongoing working groups or experts where appropriate to advise on adoption of project outcomes and developed guidelines.
- Successful extension involves taking research outcomes and packaging it useful information that can be used by growers. Many researchers / research programs are not set up / resourced to do this, and believe that adoption will come from just presenting research results or writing a scientific paper.
- A similar analogy is sales & marketing of any physical 'product'. Those that research & develop the product are highly unlikely to be the team that delivers it to the end-user. Different skill sets and strategies required.
- Fund extension and development of resources after completion of the research that has included engagement throughout with the target audience. Where research needs long duration (i.e. soil health), ensure project is funded for adequate duration.
- I think they do a pretty good job. Change is difficult. Convincing people to change is harder.
- Strengthen engagement and collaboration with service providers and other key on farm influencers
- Plan and resource the development and extension aspects of the research alongside of the planning of the research.
- Get end-users involved in design and testing of project outputs.
- Have clear, consistent and aligned RD&E pathway that is collaborative from the outset and each part (R, D & E) is valued and invested in.
- Have the capacity to fund extension and adoption, without compromising the funding of the project, i.e. don't ask for more with less. Assist with sourcing the skills and capabilities to advise/undertake adoption.
- Improve understanding among RDC staff, industry, and researchers about the importance of social science expertise for helping to improve uptake and adoption.
- More communication with end-users during the process of RD&E, so that they are "brought along for the ride", so it's not just universities/government researchers doing research for their own means.
- More clever marketing of end products.
- More communication with the researchers to know what is best way forward with projects.
- Fund ongoing targeted research.
- Fund them properly. Funding expectations from Funding bodies have not moved with increases in the costs of everything (operating e.g., consumables, salaries, travel).
- Communicate with all stakeholders early and take on board their feedback, as well as being transparent.
- Extension starts at project development.

- Multi-season trials, at a minimum.
- Have an adoption phase for selected projects - probably don't need for all (some will fail).
- Provide training for members of MACS, FACs etc in basic fisheries population dynamics and resource economics.
- Most researchers are not trained to produce products that are suitable for manufacturing. If the RDCs can employ/contract people who have these skills to work alongside researchers in mid- to late-stage research projects, this can reduce the amount of work that commercial providers need to do to make a marketable product.
- Reduce time in admin.
- Be clearer on what their expectation of project outcomes is, more realistic about achievable outputs (including pathways to adoption) and consider limiting funding to individuals/teams that have consistently failed to achieve acceptable ROIs on past projects.
- Carefully evaluate projects for their impact on growers' possible financial benefits. Environmental benefits such as; reduced needs for; chemical inputs, water and land cultivation. Ensure collaborative links are established between researchers to avoid duplication and enhance information sharing (e.g. FUSCOM).
- D&E needs to be included as a component of the research project more thoroughly.
- Pause to listen and understand rather than seek to educate, ask what are primary producers trying to accomplish and help support them. Cognitive empathy is not about warmth and kindness, it's about listening with a curious mind about the deeper level of thinking. If we can understand where grower behaviours and an organisations' capabilities align there is a solution; where we establish a behaviour is not supported, there is an opportunity to explore, one that may not have been considered without the inner voice of the grower trying to accomplish what they are trying to achieve.
- Fund extension at the end of research projects in addition to the project goals.
- Adopt 5-year research agendas, 2-3 year trial programs are too short to obtain robust results that can be extended. This would allow for better integration of research and extension so messaging is delivered to growers with more rigour in the research. Can go from applied research to on farm demonstration in the final year of the project.
- Demand better funded investments from universities to enable researchers to have their work back-filled.
- Industry will be engaged if research is geared to solutions to existing or emerging issues, and comes with a clear implementation strategy. That doesn't mean that longer-term blue-sky projects are not valuable as we don't always know what we will want or need in the future.
- Contract projects that engage with the end-user to identify the problem and work collaboratively towards a solution.
- Not just one thing: Project timelines typically too short to achieve adoption. Better support to develop CoPs so growers can work out the barriers themselves this needs ongoing facilitation and funding. Avoid overzealous application of M&E, be more comfortable with the general narrative and grower feedback. Invest in social science projects to better understand the population/s we are working with.
- There should be less bureaucracy in NSW DPI and Hort Innovation.
- Clear pathways and structures for adoption and commercialisation.
- Increased on-farm validation.
- Time post research to allow for communication and adoption strategies to be implemented...like a second phase to a project.
- More active management and engagement - not just oversight.
- Having a process by which growers and agronomists (end-users) are engaged with the project and can provide commentary or advice to the research project.
- Fund extension activities that involve researchers in seeing them through to translation.
- Multidisciplinary approach (farmers, advisers, economists as well as RD&E).
- Funding on multiple communicative channels, not just on the top 10-20% early adopters.
- Invest in ensuring extension and target audience are heavily involved in process to ensure communication and applicability of research is understood and can be acted upon (both ways ensuring researchers have greater insight into how their research will influence practice not just end-users understanding the research).
- Impact pathway mapping of projects, to ensure there is an established pathway to achieve the impact the research is supposed to achieve. This means linking research into portfolios with defined strategy to achieve bigger impact. Researchers need to be able to clearly articulate their value proposition before research is initiated.
- Be relevant, proactive and meet people where they are at.
- Understand the true needs of the end-users before commissioning RD&E projects and ensure end-users and people with extension/adoption expertise are involved from the outset rather than part way or at the end.

- Ensure that there are a clear set of RD&E medium- and long-term goals and priorities that have been developed and identified by input from numerous stakeholders to ensure that the results are productive in nature as well as preventative.
- Always partner with some form of industry. Share the good and the bad openly and regularly.
- Early scoping of their hypotheses or anticipated outcomes with those on the ground for feedback before progressing too far; and if producers are approached or asked to contribute make sure there is scope and intention to report directly back. (No one likes to be asked for information and then never hear back again.)
- End-users involved from "woe to go" i.e., initial project concept/focus/ design, regular participation in progress reporting, required variations, end-users involved in spruiking results.
- Involve extension in the outside of research project development.
- Map pathway to adoption before and during projects, this should not be an afterthought to any research project. In some instances, there will be step between growers and the work but this can be mapped and planned for.
- Communication is key. But the cotton industry is pretty good on that front conveying research to growers.
- Commission a 3-month project scoping study (\$10K) to capture pros, cons opportunities, challenges and barriers to a concept before big \$\$ are thrown at it.
- GRDC needs to keep a manager in a role for a decent amount of time and there needs to be some sort of action. There still seems to be lots of disorganisation going on and project tenders are an inefficient process to get approved. less meetings more action!
- Include D&E in research projects. Not just words, but actually investing in extension specialists to work with the researchers. Researchers are, for the most part, not social scientists. We can talk with industry, but do not have the time or interest to be all over the key methodology most appropriate to achieve adoption and demonstrate impact/evaluate. I'm not suggesting an extension specialist on every R&D project, but regionally based extension specialists that would work with multiple projects providing this expertise where and when it is required.
- Make sure that all stakeholders are engaged in the process, right from establishing research priorities and planning for projects, right through to extension and adoption. The broader the input, the better the results will be.
- Engage producers into projects early on, and engage them have them summarise the findings as outcomes and help with extension. Grower to grower extension and screening of "grower problems" always helps adoption.
- Greater clarity regarding flexibility in re-designing or altering research to accommodate new findings. Also, longer term funding for promising projects which take many years to reach maturity and desirable outcomes for industry.
- As above. Ensure access to the research results and progress. Use of extension personnel. Can the end-users see the process of the research? Is it relatively easy for them to adopt? Is it accessible - i.e., can the small end-users still benefit regardless of their size within the industry?
- Clear relevance.
- Ensure there is a clear line of sight from research to impact - end-users are identified and it is determined that there is actually a problem that needs solving.
- Engage with local farming systems groups to ensure research is what end-users want/need and make sure the extension component is well planned/funded (and not an afterthought).
- There is a lot of focus on ensuring outputs are getting into the industry now, which is great. However, think RDCs have dropped the ball in ensuring that researchers publish their methodologies so that others can appropriately peer review them. I have seen a lot of unpublished research that RDCs have then supported to commercialise that has failed because of a lack of scientific rigour. I think it is essential due diligence for research to be peer-reviewed before it is commercialised.
- Don't just tack end-user engagement and 'extension' on at the end as integrating end-users early not only builds potential delivery capacity but their input helps to generate more beneficial innovations for end-users - and that's the most fundamental requirement for adoption.
- Continued involvement of key end-users in the industry.
- Make all of their reports publicly available for free to everyone.
- Assign appropriate budgets to extension and adoption efforts, ensure you're engaging the right people to build and rollout extension (likely not the same people and often not the research team doing the R&D) and ensure a timeline long enough to begin to see adoption. Too often we discount something as not having been uptaken because there is such a short funding window and it takes time to create awareness of something new and gain momentum.
- More engagement by their membership base and end-users.
- Evaluate business impact of positive r and d outcomes before investing.

- Conduct detailed and regular (5 years, once per strategic plan) behavioural studies of their industry to find out the drivers and impediments to practice change.
- Have a definite chief aim and purpose into each project.
- Include budget for industry representation in the project.
- Researcher and RDC accountability/ assessment for the relevance, scientific credibility, and effectiveness of research products.
- Better engagement with end-users.
- Present robust, reliable value propositions to producers supported by commercial trial data and financials.
- Stop asking researchers to trim budgets because it results in sub-optimal outcomes.
- Measure change for complex problems.
- For starters, RDC's should not see every project as being something that will generate immediate impact. The other issue is that many people employed as extensionists are hopeless at extension. At best the majority could be described as facilitators that add very little value. The real question should be what extension can be done that adds value.
- Spent more time understanding desired outcomes and then barriers to change and then working backwards to the required RD or E, not other way around.
- It is not about adding the engagement as an afterthought. It needs to be there in the development. The most adopted programmes are those that built relationships with end-users prior to any research starting. They also had tenured local teams delivering the research and subsequent engagement activities. We almost need to go back to that, but with more institutions looking for full cost recovery, this may become too big a hurdle for many.
- Not so much RDCs, but providers of new technology need suitable customer support of their new products. Growers get frustrated when they install new tech etc and it breaks down and can't get support.
- Clearly defined problem definition, prioritised and coupled with understanding of scale, likelihood of adoption, translation of research or innovation into concise key messages and demonstrable practices.
- Engage and collaborate with commercialisation partners, within Australia and globally.
- Employ extension staff on ongoing / long term basis. Don't keep on losing the expertise and experience. Also have a training and mentoring of new extension staff. Have viable career pathways.
- Further funding to allow larger research projects that are interdisciplinary and allow more extension and engagement activity.
- Engage an industry representative to help end-users interpret research results and navigate administrative processes. Many end-users are sceptical of research results when research is conducted in isolation from their industry, or if they have to rely on a third party that they may perceive to have a commercial or other interest rather than an industry interest.
- Formalised and professional promotions unit that supports researchers in explaining the topic and its outcomes via video and popular articles to get the clearest and greatest exposure in a collaborative manner.
- Run a "research to practice" set of projects separately to the main research work. There will always be hurdles when adopting something new - it is critical to address these for success. And don't assume a workshop or a written piece of work will solve it - only things that are fit for market will be adopted rapidly. Surveys will not address this issue; it is through a thorough understanding of a production system that it will become apparent.
- Involvement of industry/end-users as early as possible.
- Actively link researchers and end-users, provide platforms for frequent interactions (such as inviting researchers to industry forums) not only targeted for some occasions but in general as a standing item to many occasions (open door policy) so relationships can establish and creativity together with industry develop.
- Full economic analysis not only cost/benefit. It should be considered integral part of the project. Funds for this exercise should be on top of the agreed cost.
- Part of the research should be to consider the end-use carefully and examine how it would fit within existing systems.
- The value proposition, changes required by end-users, training required by end-users and the payback period and risks for end-users should all be considered e.g. maybe a ready reckoner - To adopt this on -farm you need to (technical change/step change), You will need skills in (...), training is available from (... providers...). To test this on-farm, we recommend that you (...actions to test on farm), which would require an investment of approx (\$\$\$ and time, land area, number of stock). The risks/possible pitfalls of adopting this technology are (...). Successful adoption may increase profitability by (\$\$\$ to \$\$\$) and will take approx X years to breakeven. Demonstration of

this on-farm can be found at (... physical location/case study report/contact details of early adopter/field day to be held) and so on.

- Sufficiently fund engagement/extension within the project including pre-project engagement to understand barriers to adoption, what the end-users want.
- Ensure researchers evaluate the impact of their projects (test assumptions about adoption, monitor success or not etc).
- Ensuring of sufficient time after research completion (e.g., additional year) for extension of research findings to end-users (e.g., one-on-one visits, small stakeholder meetings), and assistance with implementation/follow up by research team members to ensure continuity and maximise value of research outputs for growers.
- Researchers and D&E teams working together from project conception stage.
- Undertake an iterative process involving researchers, industry representatives and end-users to refine objectives, outputs and outcomes before projects are funded. This could be achieved using a structured approach like that used by CSIRO ON Prime.
- Overall, I think Hort does a great job at communicating outcomes, but one thing I found with the SIP reporting process is that final reports were not considered against outcomes. E.g., communicated too early in the process.
- Putting more internal resources into extension and adoption to support projects. These resources are dwindling within many of the delivery partners.
- Realistic expectations of level and rate of adoption of research to investment.
- RDCs should play an important role in connecting researchers with end-user to better deliver the outcomes of the projects.
- Early demonstration to end-users, ease of use and incorporate changes as shortcomings become apparent during trials.
- recognise the true cost of extension and communication programs and M&E.
- Develop an extension plan and pipeline at the inception of a research project.
- More time allocated to proper planning and consultation before projects begin.
- In my view as a researcher, I find that Australian Eggs R&D team is really good and professional. They are very approachable and provide timely feedback on research proposal. I have some suggestions that could possibly help.
- Retention of R&D or program managers to get continuity.
- Provide training to the ICC panel for declaration and or understanding of conflict of Interest.
- Encourage training blue sky research scientist on how to present research findings to end-users.
- Encourage research investigators to present their findings during the industry forums and or workshops.
- Encourage research scientists to include a budget for extension as part of their project. Extension often comes at the tail end of the project and its extremely important so it would be good to discuss the plan at the very start of the project.
- Invest in to capacity building. Provide scholarships/internships to students including international students (noting that egg farmers rely a lot on overseas workers), the universities have a large number of international students who are not eligible for most of the industry scholarships/internships. If we find way to support trained international students in the country it could offer a workforce for the industry without having to rely on overseas workers.
- Facilitate close connections between researchers and industry.
- Better relationships with their levy-payers and stakeholders.
- Put more time, effort and money in to supporting end-users to trial and tweak what comes from research AND take end-users ideas and trial/demonstrate them in a scientifically rigorous way.
- Increase involvement of extension professionals in the initial scoping of R&D proposals.
- Rather than a tick the box approach to RD&E for projects, projects should be designed with clear extension goals in mind. I've worked on projects that had really good practical information but it was never communicated to industry effectively just published in scientific journals.
- Engagement with research & researchers as a core element of being in the industry - it can be hard to get people to things like workshops because they're so busy otherwise. Making those connections more streamlined, and for new agronomists to easily connect up would be great. Just adequate funding would also help - engagement is costly and as researchers we keep getting asked to do more and more in engagement activities for the same or less money.
- Dedicated extension and adoption program, resourced by specialist who work in project development through to conclusion and dissemination of findings.
- Invest in robust economic analysis of the costs and benefits of adopting research outcomes to encourage uptake by industry/end-users.

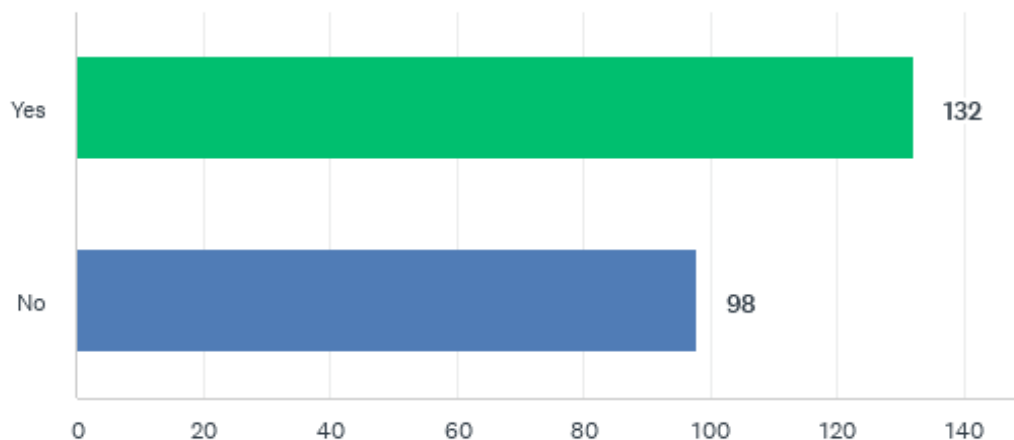
- Make their reporting forms and processes less onerous so that researchers can spend time doing the work instead of just reporting.
- Instead of "3-year research projects", RDC's could fund "3-year research + 1-year extension projects" so there is time to think & analyse results & develop best extension messages. Current system based on tight funding sees researchers spend a lot of time applying for next project funding in year 3 instead of finishing last project.
- It is important to have a face-to-face meeting/workshop to run over findings in the final report. This would be the point to organise extension and adoption strategy (i.e., no point in having an adoption strategy if the research findings do not support this action). Possibly a go-no-go point in the contract with funds allocated specifically to support adoption.
- Provide better/more industry contacts who would be willing to trial and test research.
- Give themselves more time to properly support the planning of projects so that they integrate end-user needs. It can't be expected that scientists are going to have intimate knowledge of this - they're scientists, they bring the technical knowledge and expertise, the RDCs need to provide the guidance and direction to ensure the science goes in the right direction to achieve the outcomes needed (which are defined by the RDCs through consultation with industry). The scientist will understand the problem but they likely won't have the understanding of the end-user or the commercial options or the intricacies of creating change in industry. The RDCs need to act as the mediator between industry and science, but this takes time, and money. Which means they might not be able to fund as many projects, but they fund more robust projects (this doesn't mean larger, it means the projects are given the time, support and guidance required for outcomes to be supported through to adoption).
- Include extension activities as milestones and demonstrate budget allocation to extension activities.
- Allow additional time and budget (post-research within the project or a pool of funds available to be bid for after the project) for extension. Most projects are developed to encapsulate the research component and extension is tacked on during this same period. Many of those same projects only generate an actionable, adoptable recommendation at the end of the research component and are forced to wrap up a Final Report and rule a red line under the project. It's only at this stage that the outputs could/should be developed and extended to industry. Extension during this sort of project is typically directed at 'awareness of the work' and not extending a practice-changing idea.
- Commit funds to support uptake of research findings beyond the life of the initial research project.
- Look at adoption AFTER the project. Make this the project. As a researcher who is testing a hypothesis as their project, adoption is usually beyond the project yet the MER process dictates that I must assess adoption. Evaluating projects is not just about evaluating adoption, it should also or instead include evaluation of the research quality. There is no quality control here.
- Design extension and adoption projects AFTER research has been completed to extend the results. Research projects themselves do not necessarily need to be promoted, the results from the research (which realistically is available after the final report has been accepted) needs to be tied into existing management practices with the implications of adoption (both risks and rewards) clearly articulated.
- Multiple points of access, multiple organizations pointing to each other's research.
- Get industry to ownership of the project.
- Invest in programs of work with less emphasis on projects. By jumping from one project to the next we lose emphasis on incremental change over time. Rather, we are continually striving to discover multiple silver bullets. By investing in a program of work that shares consistency in themes or in target environments, we maintain a platform through which findings from previous projects can be promoted under the new project to support incremental change in practice.
- Stop trying to make quick and cheap adoption solutions from research outcomes. The best adoption processes are created by involvement of the extension staff in the research so they have ownership and then adequately resourcing their extension work.
- Communications with producers, what producer's require research on, (common problems / improvements).
- Fund extension before research projects finish.
- Provide feedback on past research adoptions funded by provider to research community.
- Solve problems. That starts by ensuring that the perceived solution will solve the problem-owner's problem.
- Follow it through post project. Factor this into all of your projects at the proposal stage. Post research we will review uptake, 3 5 and 10 years own the track. Question why uptake is slow, understand the complexities and the knock-on effects from utilizing the outcomes. benefits from the project outcome may lead to negatives in other areas of the practice. Run an ADOPT prior to proposal development.

- Provide some continuity in research funds. For example - say the project has real potential. Develop a No/Go button that enables the current project to continue. (No/Go buttons are used to end a project, why not have it working the other way around - incentive driven No/Go buttons). I suggest have a contingency fund available to keep a project with real potential alive. When working with multi-disciplinary teams keeping staff on the job can be difficult if funding stops and then restarts. Note: the skill sets required to complete technology related projects that have the potential to increase adoption are often limited. Continuity in keeping the same employees on the job can speed up the development of technologies and hence adoption.
- Be more cognisant of the adoption literature and what can be achieved in the life of a 3 to 5 year project. In project proposals "pathway to adoption" is often required and expectations to achieve adoption while the knowledge is being developed is unrealistic.
- Create hands on and accessible learning programs associated to positive industry outcomes.
- More people at a local scale explaining the value for primary producers in a simple way, and that can also capture needs or issues they might have in the adoption phase.
- Factor in some extension activities for after the end of the project.
- Move beyond a 3-year model where the timeline for extension is synchronised with research - often research outcomes are not apparent until the end of the project - limits time and funding of appropriate and effective demonstration/extension activities.
- Engage with industry throughout the entire process. From concept through to design and trialling.
- Allow flexibility and budget to continue stakeholder engagement beyond the end of a project.
- Support longer term (> 3 years) projects with clearly defined and attainable milestones/ outputs.
- Ensure end-users are involved from the inception.
- RDC's thoroughly consult their producer base to determine the real issues that require RD&E. If those issues are real and researchable, and have not been addressed before, then engage the RD&E community. Otherwise, use the enormous amounts of information already available to package and deliver.
- Engage specialist extension providers (with appropriate skill and experience) to distribute combined project results in themed extension events. Not rely on research project staff to get each project message out. Not always their strength and time poor.
- Also, ensure outputs build on previous research - i.e. not build another standalone tool such as a DST tool solving one isolated problem".
- Make sure that all applied research starts with a clear definition of the problem. Also ground-truth project ideas with actual producers in addition to industry advisory panel members.
- Be more of a partnership with us rather than thinking they "own" us.
- Allow for an adequate budget to be built into the project for extension and communication.
- Involve intended adopters from the outset, get them onboard, be ready to amend or change based on their input.
- Balanced.
- Measure impact of their projects.
- Focus on the producer changes need to implement and ensure there are clear ROI for them to make change.
- Secure long term research funding and skilled researchers.
- Fund projects that are larger in scope and that integrate detailed engagement and adoption plans as part of the research project.
- Integrate research, development extension and education into all planning processes and increase the proportion of funding allocated to producing measurable behaviour change of end-users.
- Ensure all research trials, pilots etc all have 1-2m page plain English summaries that also tell people how to do what the paper did.
- Provide funding support for on-going employment and training of extension staff to make this high-quality resource available.
- Extend funding terms to allow longer term analysis of outcomes.
- Fund projects where there is a clear benefit which outweigh the costs.
- Consider funding a stage 2 research project if results are encouraging. Even an extension of a few years could be the best investment in terms of adoption success.
- Using available networks to ensure that collaborative activities such as harvesting, processing, storage etc are completed in a timely manner. Using their influence to ensure that commitments made by collaborators during project planning are completed.
- Ensure applicability of research as part of funding process.

- Run the extension component for an additional 3 months after the project is complete, particularly if the research is complicated or the end-user is not highly educated. In many cases the project collects data for the first couple of years, then in the final year the data is analysed, the final report is written & submitted & the project ends. Final reports are long complicated documents, not an extension tool. A better result would be to provide an additional 3 months for extension staff to write up summaries, break down the results into simpler key messages & take them back to the grower/community so that they understand what the findings were.
- Transparent RDC decision making. Currently confusing expectations are placed in tenders and after work and submission has occurred the 'goalposts' for contracting the project change (often sometimes outside the scope of the original tender/submission. Also, clear budgetary expectations so that researchers can plan and prepare the project submission accordingly.
- Properly fund projects and give realistic project and delivery time frames. There too many well thought out and budgeted projects that have budgets cut by the RDC's and as a result the outcomes are less than ideal.
- Project duration.
- At the start of the project, ensure that the successful bidders hold a series of forums (may be geographically spread) with end-users to describe the objectives and proposed activities. Feedback is sought which may largely endorse the plan (if peak industry & RDE organisation have got it right) or help change the weighting given to the different components of the project.
- Having a clear process for extension and adoption - I have not witnessed this with regard to demand/ consumer issues among the vegetable industry R&D projects.
- Understand clearly what the industry wants and needs.
- Have a balanced portfolio of R, D and E in the projects and programs.
- Better engagement with key stakeholders throughout the entire process from developing RFPS to extension of project findings.
- Include a financial cost benefit analysis or similar economic proposition with every suggested practice change.
- Not be "afraid" to take iterative steps towards a common goal and translate research results into actionable and visible changes.
- Let the private sector drive adoption. Commercialise R&D with the private sector. If you look at what the major seed and agchem companies have achieved through a commercial outlook, we can do much more with the levy.
- Have extension professionals engaged throughout the duration of research projects, not just at the end.
- Ensure the consultation is reflective of industry need, not just particular interest areas of individuals. There needs to be industry buy-in at the start.
- Get end-users involved, increase stakeholder engagement.
- Understand science communication (translate science to action) and analyse end-user behaviours, motivations etc as they apply to the research outcomes.
- Better understand the value propositions for different segments within the grower community.
- Ensuring an end-user adoption pathway against clear problem definition(s) is co-designed up front.
- Ensure adequate engagement and consultation during the project of the party required to make the change, but also the other stakeholders required to enable to change. Effective extension of the project outcomes to those required to make the change i.e outcomes and change steps are communicated in a relevant and meaningful way.
- Make sure it is a high priority industry issue.
- Ensure projects are contracted to deliver outcomes that are relevant for industry, therefore ensure early industry consultation on project ideas.
- End-user adoption focus - longer term outlook.
- Stronger extension programs, including training modules targeted at the key audience
- Spend more time understanding the problem of the end-user. Have extension officers involved in advising of how outcomes might be achieved.

Q6: Would you like to be invited to further discuss this topic?

When asked if they would like to be invited to further discuss this topic, 132 of the 230 respondents (58%) indicated that they were willing to be involved through interviews and/or focus groups.



Q7. So that we can follow-up with you, please provide your contact details

A total of 157 respondents (65%) provided their contact details.

Q8. Any final comments...

When invited to provide any final comments, several respondents commented that they were pleased to see this project underway, with comments such as ‘This is a really important topic. Thank you very much for leading this, in a pan-RDC manner; visionary and impactful!!!’ and another said ‘I’m glad this project is being funded. It is well overdue.’ The rationale is explained by this respondent: ‘As a researcher I really want to see my work make it all the way through to real world impact - for that to happen I want to be part of the extension. Thanks for the opportunity to comment on this important topic.’

Another respondent reminded us that ‘Adoption is a complex process, differing between farming enterprises. A tailored approach is needed. Local relevance is important.’ Another respondent provided this quote ‘With an empathetic mindset you let go of that need to change others or to demonstrate your competence. Instead, you listen for the deeper reasoning and philosophies within other people. Together you can explore deeper currents and work out better solutions (Young, 2015).’

All responses

- Commercial adoption may occur earlier if research developments/technologies are made publicly available.
- Good initiative to reflect on these important issues. Thanks.
- I suggest building on what's widely known already, then looking for the subtle issues that we all know require 'the hard conversations' and 'difficult decisions' and remember the private sector whose livelihood depends on getting this right.
- I have been extremely fortunate to be funded by many of the RDCs over the years. There have been some absolutely brilliant initiatives, collaborations, support and forward thinking. Also, some great people. More than happy to identify from my experience (now running projects across 14 industries here and O/S) where this has worked really well and where we have achieved significant industry change and adoption :)
- The adoption of research results is complex, particularly in fisheries in Queensland. The lack of credibility in science by end-users hinders the adoption of research results. This is an issue for the broader scientific community, rather than the individual project leader.
- Good initiative - planning and funding the development and extension is an important aspect of the adoption of research on farm. another part is the training of the extension/service providers about the research outputs and how it would be utilised on farm. this is an area that I believe we fall very short on.
- NB Q6: happy to be interviewed, but not essential that I'm involved :)

- It's important to: understand what the stakeholders want up front as this directs activities to be conducted; E needs to be varied and ongoing (not a 3 or even 5-year project but two 3-5 year projects. Adoption is a slow process; needs a cohesive team and a consistent message.
- All research must start with a clear question/s that there is an agreed need to address. Any potential outcomes that will require regulatory change must have some level of agency but in. And any that require operational or other change must have user buy in to adopt.
- With an empathetic mindset you let go of that need to change others or to demonstrate your competence. Instead, you listen for the deeper reasoning and philosophies within other people. Together you can explore deeper currents and work out better solutions" (Young, 2015).
- So important for research to be delivered on-farm in regional locations so growers can adopt practice change.
- I could potentially provide some advice as I previously worked at GRDC and used to write these activities into projects, but I'm not an expert in the field of adoption.
- As a researcher I really want to see my work make it all the way through to real world impact - for that to happen I want to be part of the extension. Thanks for the opportunity to comment on this important topic.
- Adoption is a complex process, differing between farming enterprises. A tailored approach is needed. Local relevance is important.
- Good to see this being thought about across RDCs.
- Apologies for ticking no - RD&E is not my area of speciality. I am in the extension / end-user side. But always happy to put my hand up if required.
- I think I may already be listed to chat to you anyway.
- Two-way communication and end-user engagement/involvement is very important but it also needs to be timely, be seen to be valued (i.e. feedback and updates to retain interest and show you value the end-user in the process), but (and it can sometimes be a big but) this needs to be tempered with not quashing all blue-sky research and not being unnecessarily hampered in the research aim. Respect, and being a good communicator are key and often the latter is not natural to researchers. Along with this, don't be silos tucked away in your buildings - get out there if you can.
- Thank for the opportunity to be involved.
- Great you are asking, it's the first step!
- GRDC panel members need to show a greater interest in coastal growing systems. These areas are a very reliable area for production there are a lot of growers in this area although the size of farms are not as large there is still a lot of land.
- Golly, are we still asking these questions?
- Look forward to being discussing further and being involved as I join forces with SQ Landscapes to bring everything together.
- Thank you.
- Make sure that research results are legitimate (the research process is fair and ethical, and perceived as such); that the research is relevant and co-designed with users; that is scientifically credible; that data is openly available to others; that results peer reviewed; and that it is effective in addressing the original question. RDCs could extent the assessments or research initiatives to research peers (nationally or internationally); most RDCs / program managers do not have time, capacity to assess research; RDCs are usually badly biased by the interference of political lobbying and opinions from a few loud voices. RDCs need to a lot better to improve the quality of research products particularly there needs to be more accountability for the quality of data produced by non-traditional research providers whose products particularly end up feeding updates. There is need to value science, research and development methods and processes.
- Barriers to adoption are often associated with gaps in the supply and servicing of technical equipment supplied by commercial entities. Many technology companies promote solutions, but often lack a true understanding of the needs on farm.
- Projects would benefit from having an additional 6months to 12 months period beyond submission of a final report where extension activities are funded.
- This is a really important topic. Thank you very much for leading this, in a pan-RDC manner; visionary and impactful!!!
- We are great at reinventing the wheel, but isn't it time to take stock of what we've done and work out why we need to redo it?

- Contact Australasia-Pacific Extension Network. Wide range of extension experience and expertise in both private and government roles among the members.
- Good luck!
- I am currently travelling overseas, best to contact me by email and I will call back.
- Thank you for the opportunity to submit the comments. I have worked with Australian Eggs for the last 14 years and I always enjoyed working with the team as well as egg producers. I hope I am able to continue working with them in the near future.
- The types of changes required to improve how RDC projects are able to support end-user change are systemic and cultural, and require strong leadership that challenges the current processes. But they are achievable.
- I'm glad this project is being funded. It is well overdue.
- Thank you for inviting me to participate :)
- NSW producers would benefit from getting rid of LLS and having extension services engaged in the research not just a projects-based organisation that has limited impact.
- Don't call me for a few months. Way too busy until about May. Thanks.
- Great to see RDC's actually looking into the outcomes of their projects. It's been a long time coming.
- My only concern about the follow up is the question around how long would a follow up take?
- There is a real need to address this area in a professional manner as knowledge and understanding of the adoption process is poor.
- Happy to collaborate but can't be available until mid-May 2022 unfortunately!
- The extension landscape is continually changing and is industry specific - not a one size fits all scenario.
- I feel that NSW DPI has not sufficiently involved social scientists to truly engage with the producer community. By that I mean we are very good at conducting 'white peg agronomy', but does that truly meet the needs of the primary industries community and the challenges that they face (e.g. rainfall variability, seasonal change, global market fluctuations, rising input costs, climate change, carbon storage etc.).
- This is great that this area of work is being considered and funded in a big joint study because it is such an important aspect of research AND adoption!
- A great initiative and adoption of R&D is critical.
- This sounds really exciting. Thanks.
- If someone is keen, I have a draw full of extension feedback on national program that was run by DA.
- Regular communication between researcher and RDCs is useful to develop and maintain trust and confidence. Engaging end-users is critical to the adoption of good research, backed up by industry support.
- I have held roles in industry, extension and research so am well placed to comment on this topic.
- If new options have similarities to current practice and no major capital expenses on new equipment is required there is a higher chance that research will be adopted. Researchers need to put there feet in the paddock.
- Our VegKIT (VG16064) project is in its final 6 months. At this moment it is unknown how the tools and inventions created and tested will be adopted.
- Discussion on this topic must clearly understand the difference between extension (targeted change) and communication (raised awareness).
- There is a lot of potential to lift the industry to a new level, however this needs a practical, pragmatic and iterative approach and shouldn't "wait" for a hypothetical high-level project.
- Survey inputs are based on my observations and discussions at both industry and producer level over the last 18 months.
- Happy to discuss if you see a benefit, but wouldn't be concerned if there were other people you'd like to follow up with instead.

Appendix 7: Focus groups

Background

An industry stakeholder survey was undertaken to investigate ways to better integrate extension into research projects to enable greater end-user change. A total of 241 responses were recorded, greatly exceeding the hope of receiving 100 responses. Over half (58%) of the respondents indicated that they were willing to be further involved through interviews and/or focus groups. A flipped learning approach was used, where some background material was sent to the participants prior to the meetings. They were invited to:

- watch a [short video](#) (7 minutes) where a brief overview of the survey results was provided,
- read the survey summary of the report (3 pages), and/or
- read the full report (35 pages).

A series of six online focus groups were subsequently conducted with 30 participants to explore the ideas generated in the survey. This report outlines the findings that emerged from the focus groups.

Summary

The high engagement with the survey was attributed to the topic of integrating extension into research as being a current hot topic across the industries. Many are highly aware of the challenge of not being able to effectively translate research findings into on-the-ground actions. Many of the researchers (who made up almost half of the respondents) want their work to make a difference. The focus groups acknowledged that the expectations of RDCs have gradually shifted to incorporate adoption, but generally the system remains the same and the support required for greater adoption is often not available. System-level changes have been advocated (e.g., best practices, project design, collaborations between RDCs) to address the issues around extension and adoption.

Key issues that emerged when identifying the difficulties in achieving effective extension and adoption are:

- **Extension is not being emphasised due to a lack of awareness or the nature of the research.** Although the awareness has been increasing due to the changing expectations of RDCs, and a lot of effort has been put into the space, some projects still do not have an extension component. Sometimes researchers develop project proposals without consulting extension specialists and miss opportunities to integrate adoption in the design of the project.
- **Extension is not being prioritised due to a lack of resources, including time, budget, expertise, and trial sites.** When resources are limited, research output tends to be the priority instead of extension. Adoption and implementation on-farm often takes a long time, which may exceed the timeframe of the project. A three-year project may only result in developing the product or awareness change. Budget constraints limit the ability to find the right expertise that the project needs (e.g., extension specialists, economists, social scientists) as well as the trial sites (ideally multiple farms spread out across regions beyond the research site).
- **Adoption is not ideal due to the project focus.** Projects funded may fulfil the need identified by the industry body, but not the actual end-users. Some projects are more theoretically focused and don't have results that can be applied on-farm.
- **Extension not being effective due to limited skills and connections.** Researchers tend to have limited connections and access to end-users. Some researchers only want to focus on the research, and some may want to do extension but lack the proper skills.
- **End-users are hard-to-reach, and the coverage is limited.** The proportion of end-users that can be engaged is limited due to their time constraints, a lack of interest, and not being aware of the research. This results in the fact that it is always the same group of farmers and growers being stretched and involved in different projects, and they may already have been converted.

Potential solutions that emerged from the discussion targeting the key issues include:

Key issue 1: Extension is not being emphasised due to a lack of awareness or the nature of the research.

- **Build the requirements into the proposal phase.** One solution that emerged to ensure there is an extension component in the research project is to require the project leaders to consider it and engage with the industry right from the beginning when putting together the proposal. Proposals could also serve as a step to segment the research based on their adaptability (e.g., pure research vs applied).

- **Manage expectations depending on timing and research type.** Understand the fact that some projects are pure research focused and may not be able to generate on-farm impact quickly or at all. In some cases, the results are not most needed when the research finishes.
- **Build a specialised extension team or bring in commercial partners.** Another option mentioned by the focus groups is to have a recognised, external extension support available for all research projects. It could be an extension team in the RDC, a project officer overseeing extension, or contracted to commercial partners. It needs to be noted that there is a risk of sending out mixed messages if the person is not fully familiar with the research. IP issues may also occur when involving external companies. The planning, funding and reporting of extension needs to be separated from the research activities to prevent dilution and reduced emphasis.

Key issue 2: Extension is not being prioritised due to a lack of resources (including time, budget, expertise, and trial sites).

- **Co-fund projects with a bigger impact between RDCs and private sectors.** RDCs should consider cross-sectoral opportunities and collaborate to support larger projects that have an impact on system-level transformation. This means the project will have more resources and a higher chance of getting into the proper extension phase, thus a larger scale of impact. RDCs need to communicate better strategically and identify and nurture those crossovers. Involving private sectors that are not used to investing in R&DE is also worth considering.
- **Extend the length of the project.** RDCs should be willing to scale up projects or extend the research timeframe to enable greater time for adoption. If the outcomes of the research are deemed practical and economically viable, then a trigger point could be initiated to move into the second phase of the project, focusing on development and adoption. This should be led by the extension team rather than the original research group. This phase will work with ‘test pilot’ growers to iron-out integration problems and further extend it to other growers.

Key issue 3: Adoption is not ideal due to the project focus.

- **Look back and learn from the past to make sure the project has the right focus.** Changes occur when the pain of staying the same is greater than changing. The degree of adoption will depend on how relevant the project is to the end-users in terms of practical use, on-farm integration and economic benefit. Projects should review what has been done, what worked (both the research topic and its extension component) and what did not to ensure the project focus hits the mark and prevent duplication. A proper evaluation of a project’s impact (e.g., 2-3 years after it finishes) will also help inform future projects.
- **Understand the real needs on the ground.** Research (e.g., ex-ante analysis) looking into what end-users are really looking for is critical to ensure the research funded has real value. RDCs need to have greater insight into this, so they have a better understanding of where to invest.
- **Receive ongoing feedback.** Having some end-users on the project advisory group/ committee is an extremely useful way to get ongoing feedback. This prevents the problems that arise from only having discussions at the beginning and end of some projects, which can result in a disconnect between the proposal and the implementation of the project. Engaging end-users early also helps the project team to understand the risks in adoption and be clearer about the required outputs/outcomes.

Key issue 4: Extension not being effective due to limited skills and connections.

- **Provide extension training to the team.** A common theme is a lack of extension skills in the research community, but articulating the project’s features, advantages, and benefits is critical. Training can be provided to researchers so that they can have the skills (e.g., using appropriate language) to communicate better with the end-users.
- **Build a multi-disciplinary team.** Researchers sometimes are already overwhelmed with different tasks and projects, so having people who specialise in extension and other critical skills out of the researchers’ skill set in the team to help free up their time will be more realistic. Note that these people are best to be involved from the beginning of the project to maximise the impact.

- **Nurture the next generation.** Investing in the development and training of the next generation of researchers in the extension space is also critical in succession planning and mitigating the negative impacts of staff turnover. Internships could be built into projects, and a requirement of having an early career researcher could be added to the proposal template.

Key issue 5: End-users are hard-to-reach, and the coverage is limited.

- **Build trust with end-users and use trusted sources.** Engagement and adoption require end-users to trust that the information is practical and beneficial to their farm. RDCs should aim to build the trust between them and the end-users or identify “champions” (e.g., opinion leaders, trusted local independent groups, or farm consultants) to sell the messages.
- **Respect their time.** End-users have already busy with their jobs, and their time participating in the research should be acknowledged and reimbursed. Information targeting end-users should also be manageable, and avoid using channels they are unfamiliar with.
- **Provide evidence.** Providing solid evidence on the research benefits can increase buy-in compared to only providing statements. Cost-benefit analysis is also helpful to enable end-users to be motivated in considering if the product will benefit their business.
- **Provide support and training.** Consider ways of better supporting farmers. Ongoing training and support should be provided to end-users after the project if the adoption needs a step-change in technology.
- **Investigate barriers and enablers in adoption.** Psychological or other drivers that impact the research uptake need to be well-investigated to understand why extensive extension has resulted in limited or varied impact. This also ensures that what is being researched is what end-users are interested in.
- **Involve the end-users from the beginning.** A recurring theme emerged from the discussions: engage end-users early and bring them along the journey. This means asking for and listening to their opinions, allowing them to get hands-on with the research, and making sure the research is focusing on their real problems.

Findings by questions

Here are the detailed responses to the focus group questions.

Q1. Why do you think so many people responded?

- **Right topic** – research and the impact of the funding (therefore extension!) are hot topics that strike a chord at the moment. RDCs are focusing more on extension, but researchers tend not to know what it means at a practical level. “I don’t want to do research for the sake of researching”.
- **Right audience** – the survey was targeted at people who are keen and/or whose responsibility is to look into the system and make changes (e.g., researchers). Everyone in this area is passionate about this and/or frustrated with the system not being effective enough. Millions of dollars are invested and it’s important to get good impact. Problems such as duplication and disconnection between RDCs and end-users persist.
- **Proves the need**
 - **Lack of extension as a focus** – lack of effective extension and regionalisation in research projects as the research output is often the priority. There is a gap in the extension/adoption space. This is especially the case when it comes to blue-sky research with little applied work (e.g., those in the university context).
 - **Lack of extension expertise** – no one in the team has the expertise/training in extension. Some researchers are keen to get in front of end-users but don’t know how to do so, especially with new generations coming into the picture and the increased use of digital comms platforms. Some researchers only want to do research and then need other people to be in the team to do extension/comms. Sometimes there is a lot of information but end-users have limited time that they can’t get across it all.
 - **Lack of demand** – there is no community to engage with for some projects. They get frustrated when they fail to get the message out. Need to have mechanisms for true development with end-users.

- **Disconnection between expectations and realities** – RDCs have expectations for the impact of the investment (i.e., adoption/change of practice, not just the presence of extension in the project), but the reality is that it's hard for researchers to connect with farmers and get grassroots information and hard to find people with capability and capacity for extension. The expectation has been set, but the system is still the same and lacks clear instructions. The world has changed, but the funding models have not (or not in the same way) and often the means of getting results to market have also not changed.

Q2. *Almost two-thirds of the respondents indicated the reason that RD&E projects are widely adopted by industry is because there are clear benefits (production, profitability, environmental and/or social) for the end-users. How can we better ensure projects do deliver clear benefits and communicate those benefits to end-users, so more might adopt the practice change or innovation?*

- **Build trust** – need to build the trust in the research and the RDC so that the end-users can be assured that the results will be practical and beneficial to them.
- **Learn from the past** – look back and see what used to work and when (e.g., including extension specialists in the project team).
- **Manage expectations and objectives on timing** – timeframes for adoption can range from less than two seasons or up to 10 years. RDCs could acknowledge this. It will depend on whether what is offered is meeting an unmet need or only has minor benefit, is poorly communicated or complicated/costly to integrate. In addition, sometimes the timing is not right and the findings need to be revisited at a later date.
- **Better involve end-users** – acknowledge that end-users have limited time and can also be difficult to engage. However, be mindful that sometimes end-users have difficulty in articulating questions that research can answer. If this is the case sometimes advisors/consultants can be used to develop questions. The bottom line is to engage end-users, even if it's just a few phone calls. Bring end-users along the journey and allow space for them to try and fail. Build ownership even if the answer won't arrive until the last minute.
- **Support researchers in doing extension** – support researchers/extensionists with time and money to involve end-users from the beginning.
- **Align research outcomes with market requirements and certifications**
- **The need for development** – Need the step in between research and extension, i.e., development. This is about making sure the product is fit for market, developing a tangible product that end-users could use and then guide them step by step rather than just dumping information about the product. This takes time and money!
- **Role of commercial partners/private sector** – one solution is to bring in commercial partners to use their experience in product creation and commercialisation. However, this may cause conflicts on IP management and prevent the innovation from being shared and adopted widely if you get locked into one commercial partner. A solution is to just involve commercial partners to help improve engagement and gather feedback to make the product suitable for commercialisation then share with multiple commercial partners to adopt. Private sector organisations in Australia are not used to investing in R&D though. How can we build R&D into their business model to get more funding for the projects?
- **Provide evidence** – value proposition needs to be clearly stated and delivered in multiple formats with testimonials instead of just providing general statements. Demonstrate benefits clearly with farmers on the ground (e.g., provide cost-benefit analysis so end-users can make decisions based on this. Quantify the economic and lifestyle benefits). There needs to be far more financial analysis build into projects.
- **Use champions** – sometimes people just won't adopt even if benefits are articulated. Use champions (e.g., trusted local independent groups) to sell the messages.

- **Understand barriers and drivers of change**– understand thoroughly the needs and issues that actually exist (not just listening to one or two voices). Sometimes industry might want to tackle a problem they see but it's complicated (e.g., environmental issues). End-users might not see the issues at all or see any clear benefits to them in the short term. When things are rapidly adopted, they are addressing a real need. Changes occur when the pain of staying the same is greater than changing. Fund projects that can show that the project benefits farmers not others.
- **Use existing channels** – end-users tend to be time poor so use what's already there / tap into things that are already happening.

Q3. *The other most popular responses to that question were ‘High level of extension engagement and two-way communication with end-users throughout the project’, and also ‘Industry representatives engaged throughout the project’. Why might this often be difficult for project teams?*

- **Location and regionality** – for example, researchers based in universities will not have easy access to the farms and interact with end-users.
- **Information sources** – understand who the trusted information source is to end-users (e.g., consultants they are already working with) and work with them to release information. Otherwise, build trust between researchers and end-users.
- **Staff turnover** – means the established connection is likely to be lost if the key staff leaves (e.g., some organisations are losing young scientists who are skilled at presenting at extension activities). High profile researchers are already overcommitted. Need to invest in development and training for the next generation of researchers and extension. One solution is to have a requirement that there needs to be an early career researcher involved and get the opportunities out there (succession planning).
- **Limited resources** – budget, time, personnel, sites. Sometime there are budgetary and time impediments, as in, the research gets first priority on the money. Time can be limited, and extension can also be hard when the project time frame is short. Some short-term projects won’t involve end-users and haven’t involved them in the first place. The budget could also limit the ability to hire people who have relationships with end-users. Time constraints also happen when people are on multiple projects. Sometimes it is resources (e.g., no research sites beyond the main research site).
- **Extension skills** – some researchers and engineers aren’t good at / do not have any experience in interacting with end-users (and they may be a little afraid because of this). It’s not their responsibility either. Options are to have a conduit in the middle to help bridge the gap between these researchers and end-users or add training in this space.
- **Right language** – language to articulate projects to end-users’ needs to depend on the situation. Need simple language for key benefits and allow end-users who can engage more to communicate with peers about the research. Need to have different formats to get the information out.
- **Project focus** – RDCs need to be careful about if the project is really solving problems end-users are facing. Adoption will depend on how relevant the research is to end-users. In addition, researchers can be driven by the loudest voices in a sector, rather than the pressing problems for the whole sector.
- **Limited coverage** – whole interaction is a challenging process. End-users who are actively engaged in research are always the same, and the proportion of growers that are able to engage is small. Need to gauge end-users, understand more, and have local demonstrations to expand coverage. Another related problem is that the number of end-users is already small and all have been stretched and involved in different parts of the industry. Note that those who are willing to come out and participate may already be converted. Need to reach the hard-to-reach ones.
- **Lack of best practice (e.g., proposals)** – develop a clear process that applies across RDCs to ask projects to engage with what the industry requires (e.g., when they put together the proposal according to requirements). Proposals may require engagement with the industry in the first place. Also, not everything has to be in the one project. Maybe split things up a little more or carry out work in parallel. Almost half of the dollars should be allocated to extension at some point in the project.
- **Funding** – funding is largely focused on a single aspect of the system. There are limited projects focused on systems (i.e., from farm to the consumers mouth). If you are serious about change a single commodity focus for some issues will not be enough. RDCs should also stop funding decisions from being influenced by political factors.
- **The change in the extension landscape** – previously state government departments provided district/regional based extension and the extension work would ‘just happen’ through the connections between researchers and extension. This system does not exist anymore and there is limited acknowledgement of that in some sectors/regions. This has impacted not just knowledge but also

relationships and this has all negatively impacted the effectiveness of extension. Even within RDCs this can be a barrier as there is an R&D team and extension team and this can create a barrier.

Q4. *In the survey report, Q4 explored the reasons for less-than-optimal adoption of research results. We've already talked about the value proposition, so let's now look at the next most popular response, that the changes required of end-users are too complex and not easily trialled. How might we change the way we undertake projects to minimise these limitations?*

- **Investigate psychological factors / behavioural economy** – probably needs a little bit of research around psychological barriers considering the complexity of different farming systems. Learn about why people change to understand their drivers and motivators. A multidisciplinary team can help with this. Sometimes there is a focus on early adopters but be aware they will already be trialling different ideas themselves.
- **Flexible approach depending on the nature of the research/technology** – some are easy to trial, but others just don't change no matter what the research show. Be willing to scale a project so it's easy to demonstrate, e.g., it usually makes sense to producers to look at the whole rather than the part. Often the next step is not adoption but increasing awareness, knowledge and skills. Perhaps there is too much expectation for practice change. Sometimes it's OK to have a 'half-baked' research idea, as long as this is recognised at the proposal stage and there is allowance made for follow-on work.
- **Provide training** – training should be provided to end-users if the adoption needs a step-change in technology.
- **Manage expectations** – acknowledge the difficulty and thus the length of the project, if the outcome can be seen or if the problem is more complicated. Acknowledge the possibility that the research could fail (e.g., vaccine development). Adoption comes down to timing as well as individual end-users. It could take a longer period of time than 3 to 5 years (3 years may only get to awareness rather than implementation). When it's pure research, should they be responsible for adoption? Or should extension be involved so that they are aware of what the research on and will be able to help if the work continues.
- **Engage end-users** – engage them in the process and guide them, step by step, so that they can see what parts can be applied to their farm and minimise risks.
 - **Listen to end-users** – ensure the research, especially BAU research, is asked for by growers. Involve them in the development/design phase and focus on applying the technology on-farm rather than generating reports.
 - **Start the engagement early** – engage end-users early, especially for complicated projects, to run through potential outcomes and changes required to understand potential risk in adoption, know how much engagement is needed, and manage expectations (e.g., some producers may think a solution is a year away when the research will take much longer than that). Be clear about outputs/outcomes needed and resource it appropriately. Note that end-users may be disappointed if they are being brought in early and only realise that the product won't be available in another three years.
 - **Get grower influencers** – involve two to three end-users who are influential and respected onto the advisory panel to get their ideas.
 - **Have different trialling sites** – set up a core research site (e.g., research station or respected/good local growers) and multiple satellite sites. Then have trialling in growers' sites, asking for their opinions and input. There are great examples of commercial sites developed for research that host six to seven projects and allow industry to see what is being done (e.g., the Almond Centre for Excellence).
- **Look back** – look at those less-than-successful projects and see how their team transferred innovation into the field. Look at what happened to date, what we know and don't know, and decide what is actually needed. Need

to build this into the review process. Do a literature review before designing the project or make this a milestone with a stop/go point.

- **Present outcomes** – need both technical and field-based language. Understand end-users' skillset. It's about how the research outcomes are presented. Need to bring it back to the basics and keep the benefits front and centre.
- **Note:** a focus group participant later clarified that... a *complicated* system has many working parts, but we have some understanding of those parts and can attempt to make sense of it. A *complex* system has many unknown parts and as such we can only guess as to how it works. Research that is generally trying to deliver improvements deals in the realm of the complicated. Blue sky research addresses the unknowns and looks at the complex, but it might never result in a deliverable solution, as it is not clear where the identified output might fit or what changes it might result in.

Q5. When asked what's the one thing that RDCs could do differently to ensure better outcomes for their RD&E projects, five themes emerged. They were:

- *extending the length of projects,*
- *better incorporating extension,*
- *better engaging stakeholders,*
- *using a co-innovation approach, and*
- *better understanding the psychological drivers for practice change.*

Looking across these themes, and building on what has already been discussed around them, what's the one thing you'd like changed?

- **Extend project timeframe** – Extending the research to ensure extension is incorporated while the research is still underway would be helpful and has become more common these days – note that this does not fit for all projects. Maybe have an extra 3/6 months of funding that's dedicated for adoption.
- **On-going extension engagement** – throughout the life of a research project have engagement with extension whether via regular connection with end-users or an advisory group. Use a co-innovation approach. Use extension to prime end-users for the research.
- **Collect ongoing feedback** – group stakeholders based on what research theme they are interested in and have regular meetings on that theme to get ongoing feedback. The feedback then could be fed into the specific projects under that theme. This prevents the discussion from being carried out only at the beginning and results in a disconnect between the proposal and the implementation of the project. It also helps direct the bigger projects. Involve senior consultants if getting to farmers is difficult.
- **Co-innovation between RDCs** – this is important and RDCs are trying but has not gotten there yet. More often **there** is a lack of collaboration between RDCs (e.g., weed management; irrigation). One thing could do is look into projects that link to different sector groups and be incorporated across RDC types (growers can see what works elsewhere). This also means having more money (from different RDCs) and a higher chance of getting into the extension/adoption phase. There may be a need to address communication between RDCs and to jointly decide on strategies.
- **Co-design strategies** – RDCs need to communicate better and identify and nurture those crossovers rather than rely on project investigators as they are often already being caught up between multiple roles. RDCs should come together and jointly decide on strategies across industries.
- **Acknowledge the decision-making processes that drive impact of projects** – RDCs have decision making processes that drive behaviour. Make these explicit and see if they are driving the behaviour needed. Beyond the RDCs, governments make decisions that drive this too and often there is duplication.

- **Investigate psychological factors** – Psychological drivers that impact the uptake of the research have emerged **but** are not well-investigated. This is important to help understand why the change in behaviour is not happening on the farm despite extensive extension being undertaken.
- **Properly review and design the project** – allow enough time to flesh out the project and its long-term value. Develop a checklist for the tender and ensure all key personnel (social scientists, economists, etc) are included.
- **Acknowledge time input from end-users** – conscious of asking input from end-users for the research as time is tight for some (even for those who would be good to be involved). There is no clear policy around reimbursing for time, and the RDC needs to look into it to acknowledge that time invested by end-users is valuable.
- **Improve proposal to segment projects** – have clear definitions for different types of research projects (e.g., pure research vs applied) and have appropriate expectations for their impact. This should link to the design of the proposals.
- **Find out the real demand** – ex-ante analysis to get insights in terms of the right area is to invest. Design the best project for the issue that has real values and could help the whole system. Ground truth the ideas.
- **Get co-funding** – Get co-funding between RDCs and/or with private sectors to fund bigger projects with bigger but manageable risks. Focus on projects that have a greater impact on the transformation of the system rather than just short-term/rapid turnaround.
- **Build a multi-discipline team** – extension officers work with researchers to help them understand the issue. Can't expect the researchers to be extension people, so need to have the right people and resources from the beginning. Have a project officer be the contact point for inquiries rather than researchers.
- **Competition between agencies** – research organisations are competitive, and the communication between researchers isn't open.
- **Acknowledge the need for extension** – need to acknowledge that adoption/marketing is needed at the end and that this is the link between researchers and adoption. Have a real commitment to funding adoption and measure the benefits of that. Another option is to have a specialised team in the RDC do extension and get all projects to work with this team. This could prevent the information from being shelved, but there is a danger of mixed messaging if the person in charge of extension is not dedicated to one project.
- **Evaluate the projects** – revisit projects after 2 to 3 years and see how much adoption there has been.

Focus group participants

Name	RDC (or associated industry)	Organisation
Abigail Jenkins	Multiple RDCs	NSW DPI
Amy Fay	Dairy Australia	Murray Dairy
Angela Steain	Hort Innovation	Freshcare Ltd
Annelies McGaw	AgriFutures	AgriFutures Australia
Bianca Cairns	Hort Innovation	Hort Innovation
Bridie Schultz	Multiple RDCs	Sativus
Bronwyn Walsh	Hort Innovation	WA Citrus
Byron de Kock	Hort Innovation	Hort Innovation
Daniel Rodriguez	Grains RDC	UQ
Eric Koetz	Cotton RDC	NSW DPI
Graham Harris	Multiple RDCs	DAF
Helen Burns	Multiple RDCs	NSW DPI
Iva Quarisa	Multiple RDCs	Irrigation Research & Extension Committee
Janelle Montgomery	Cotton RDC	CottonInfo
Janine Powell	Cotton RDC	Ag Econ
Jason Amos	Wine Australia	Lallemand
Jenny Treeby	Hort Innovation	Australian Table Grape Association
Jo McKiernan	Multiple RDCs	NSW DPI
John Cameron	Grains RDC	ICAN
Kapil Chousalkar	Australian Eggs	The University of Adelaide
Laura Skipworth	AgriFutures	AgriFutures Australia
Narelle Moore	Grains RDC	NSW DPI
Olive Hood	Hort Innovation	Hort Innovation
Oliver Knox	Cotton RDC	UNE
Paul Petrie	Multiple RDCs	SARDI
Peter Crisp	Multiple RDCs	SARDI
Sally Ceeney	Cotton RDC	Cotton Australia
Sean Murphy	Meat & Livestock Australia	NSW DPI
Steven Falivene	Hort Innovation	NSW DPI
Todd Andrews	Meat & Livestock Australia	NSW DPI

Appendix 8: Co-design workshop

A co-design workshop was conducted on Wednesday 25 May 2022, with 30 participants from across various industries and regions in Australia. The following are the notes that were recorded in the Jamboard sessions. The material in **Appendix 8a** was sent to participants to read beforehand.

What we've learnt so far

- Stop, review and adjust at different stages.
- Most people involved in the project seem to be on the same page.
- The vast majority of people giving feedback look to be on the same page with what's required to deliver effective RD&E.
- Research adoption is an ecosystem and not linear.
- I think it confirms a lot that we already know; not a bad thing! I think distilling the info into the 4 main themes is a helpful springboard.
- Good to start with outcomes required before the project (bigger picture) - rather than start with the project.
- I like the theory of change approach.
- Always need to understand 'adoption of research' in the context of industry and business level strategies /bring a holistic perspective.
- The themes certainly resonate - in addition, you need a certain level of understanding and capability of those involved that enables these things to happen well.
- When end-users start the process, it works much better!
- Lots of cross over between the first three themes - are they essentially the same.
- What framework we design to achieve best principles for adoption is the challenge.
- Farmer-centred design approaches probably need 'prior resourcing' to enable development of proposals and budgets.
- Funders should provide time and money for pre- and post-research activities that aid in adoption.
- I like the co-design approach where we need the end-users involved from the start - Farmer Mentors.
- I learnt that there are new models of extension/ engagement that have advanced over prior PAL.
- Acting in isolation will not unpack ideas at the user end.
- Clearly articulating the problem space is key to providing the right solutions.
- Adequate resourcing is critical.
- I didn't see anything or where the feedback loop on what worked and what didn't fits.
- Resourcing needs to enable inclusion of skilled communicators.
- Involving end-users from the start is important. Any end-users (e.g. growers) in this meeting?
- Different approaches for different stages.
- Co-design is critical to successful outcomes.
- Longer term projects will have a better chance of increasing uptake.
- Start thinking about adoption pathways from the start of project development - ongoing process throughout.

- Timeline is important for determining the best approach i.e. pre or post project funding opportunity.
- The different models to describe types of engagement.
- Intrigued that there is a process behind what we tend to have learnt to wing over time from success and failure.
- Understanding barriers and enablers and non-adoption is a reasonable response.
- Collaboration across the RD&E platform is needed.
- We normally work with commercial growers (varying degrees of co-design), but this doesn't provide broadscale engagement without additional extension.
- Being able to properly describe (with metrics) the issue is critical.
- 4 themes make sense and summarise previous discussions well.
- Engagement with the public at every step of the project.
- Collaboration is key. Farmer-centred extension programs including a Theory of Change.
- Very much agree with the problem and am happy to see innovative solutions proposed.
- Collaboration involving all stakeholders in the design phase, including end-users.
- Theory of change - working backwards to design an adoption pathway.
- Importance of a co-design approach that fits the context.
- Resourcing and especially having the end-users available to participate is key.

What did you whole-heartedly agree with?

- Interactive/ collaborative research projects are more fun as well as improving opportunities for adoption/ impact.
- Need for industry engagement.
- Bringing in the end-user right from the beginning of the project.
- Different approaches for different clients and levels.
- Ensuring growers see value in the research and that it adds value.
- Involving end-users in the collaboration space.
- Theory of change approach works from what you want to change and work backwards.
- Program rather than projects.
- Focus on evidence.
- Buy-in from the start from end-users at the start; critical to adoption.
- As a researcher, it is good to see a focus on bringing in extension into the planning process.
- Good to see the RDCs are collaborating and invested in this area as they will be a significant contributor in driving this change.
- Longer projects > shorter projects.
- Having end-users involved in the end process.

- Building trust with end-users.
- Resourcing (time), longer projects including access to end-users.
- Themes consistent with our experience - has been a shift towards collaboration/growers driven research.
- Need adequate resources for E in R&D project.
- Agree with the thinking around the process of developing a project.
- Engagement with end-users, building trust with end-users.
- Quadrant system looks promising.
- Evidence-driven identifying barriers for adoption is crucial.
- Adoption pathway; working backwards from the grower to inform and help design the R&D process.
- Collaboration across the whole rde platform.
- Focus on co-design and transcending the silos that exist is really exciting.
- Check in and involve the end-users during the process.
- 4 themes resonated for moving forward in RD&E.
- Importance of also doing extension at a program level (vs just project levels) to avoid contradictions.
- Need to have focus on adoption throughout programme.
- Nothing surprising in the report, agreed with pretty much everything.
- Grower-level engagement in research does not necessarily translate to industry uptake.
- Can require multi-layered approaches e.g. higher level roles for RDC program managers to drive extension.

What did you disagree with?

- Farmer-centred design with a scientific rationale.
- Practice change for farmers will require practice change by researchers.
- Need to turn the term "end-user" on its head. They are the starting point.
- We shouldn't always assume that all people are capable of change and want to change. They will always know more than us :)
- Different end-users, whole range of context and end-user requirements that needs a broad range of solutions. It's very hard to get them all through to find a realistic solution within time frames. Some don't want to consult or participate rather stay back and not engage actively.
- Engagement fatigue - these people have jobs as well.
- Are the top three themes all that distinct? Maybe they are all versions of co-design.
- Growers don't know what they don't know.
- Moving away from the term extension because it implies "tacked on at the end" - call it innovation instead.
- Theory of change can be questioned - driver is not only money. e.g. lifestyle priorities may drive adoption.
- Too much jargon in this field - it becomes more confusing for researchers.
- Selection bias - we only talk to the same people over and over.

- Lack of understanding of the complexity of customers' working life.
- Often 100s of projects on the go - how do you integrate extension, find out how to add value (may not know until the end)?
- Theory of change isn't just based on overcoming psychological barriers; recognising that economics and market forces apply and should be considered is important.
- Conflicting interests - need to order our priorities.
- Collaboration/ Co-innovation may only reach those directly involved, not necessarily ensuring widespread uptake.
- Questions re top right quadrant - what are examples of this in practice? There is a place for blue sky research though.
- CSIRO ADOPT tool is useful.
- CSIRO Pathways to Impact is now the currently applied model.
- Impact pathway approach can help embed 'adoption strategies' throughout the life of research.

What's missing?

- How can we capture the impact within the 5-year projects? Some impacts you don't see for 10 or 20 years? How can we do long-term evaluation?
- How will the system work e.g. cotton: 5 people and way too many projects for them. How do you choose?
- More emphasis on feedback - what worked, what didn't.
- Need to address resourcing - right skills and capabilities (there is a wider skills gap in the sector).
- How do we adopt the solutions internally?
- Awareness of challenges of segmentation.
- Capability development and cultural shifts are crucial and sometimes/ often lacking, challenging the feasibility.
- Commercialisation and IP issues.
- Need more consideration of the innovation needed in how we deliver projects and meet end-users needs; how do we incorporate the flexibility necessary?
- Need to get RDCs involved with more engagement in projects.
- Who drives the whole process? Who is responsible for embedding the solutions? Is the researcher the best person to do that?
- When to get end-users involved - may not know the project's value until the end.
- Leadership is vital to success.
- Big issues around risk and the size of change.
- Training required for leaders of the codesign process.
- Explicit connections to industry R&D investment plans as a mechanism to ground/guide research from outset and provide clues for how to optimise adoption.

- The discussion shouldn't just be around a single R&D project but around the larger industry need. A single project may only be part of the required suite of things required to meet the needs of the industry.
- Different end-users, a whole range of context and end-user requirements that need a broad range of solutions. It's very hard to get them all through to find a realistic solution within time frames. Some don't want to consult or participate rather stay back and not engage actively. How do we address this?
- Broader context; more triple line theory needs to be incorporated. Currently missing at the moment.
- Researchers get judged on very academic metrics - this complicates things.
- Increase understanding of what drives adoption; do we really know what the levers are?
- Understanding of the full farm system.
- Role of agribusiness, commercial in projects, seems to focus on research to farmer/producer.
- Trust - open communication. Detail for co-design process (the devil is in the detail). Not straightforward.

Comments on the quadrant framework

- Stakeholders may change depending on which box.
- End-user – term makes us still think linear.
- Potentially a number of research projects currently fit in D. Research complete now, ready to extend.
- Research done, now co-designing, looking where project fits. E.g., bringing in supermarkets to help with co-design.
- Useful, raises awareness of where you fit, the different points of view.
- Habit of applying language without thinking about meaning; this helps us to be mindful about outcomes/goals.
- Important to contextualise the space you are in; so this is useful.
- Need to review this regularly throughout the project, not just once as it will evolve as time goes on.
- In A and B still need to be able to understand and refine the problem space.
- This seems to give the issue context within the industry but may not give the extension context.
- The table seems to have jumped past the problem definition phase.
- Re D: Not sure we can co-design without a ready solution or output.
- Quadrant A: focus on D.
- Quadrant C: focus on E.
- C and D would be more common generally, as we would have needs described to us.
- You wouldn't stick with one part of the quadrant through the project.
- A little simplistic.
- Sometimes still need co-design/collab/consultation. Need clearer examples of when co-design is not needed.
- Quadrant B: This seems like a blue-sky meeting. Grappling with this one.
- Don't see a distinction between C&D - still need to work out how to extend it/make it usable.

- Quadrant D: This is - What do we need to research?

Principles and steps to get there

- Carefully think about the end point.
- Form a team - project leader group/ project reference group.
- Make sure teams are representative.
- Build in an evaluation mechanism.
- Make use of the quadrant.
- Spend the time trying to get the right people on your team.
- Get people involved at the start.
- Engagement (end-user).
 - Identification of: regional influencer, early adopter, social influence.
 - Problem still needs to be defined prior to the start of research.
- Industry wide OR private company OR public policy that affects the industry.
 - Consider the economic bottom line of the end-user. Can be immediate or long term.
- Work priority.
 - End-user vs researcher (e.g. papers).
- Include D.
 - Often heavy focus on R and then E, but increasing D will lead to improved E.
 - e.g. increasing scale can be critical.
 - Helps where E staff have been reduced.
 - Ensure that research includes real world (and all its confounding effects).
- Infinity loop! Extension helps to drive research.
 - Assisted by larger programs of work, long-term strategic agreements.
- How do we tap into the wider network of stakeholders?
- How do we know who the right people to co-design with are?
- When do we engage? After funding? Before funding?
- Create a toolkit?
- Getting the incentives right.
- Make sure you're touching base with all stakeholders, government etc.
- Wisdom of crowds.
- Move away from the research project being the centre of it all - focus on the problem definition/ problem solving.

- Having a program logic is essential.
- Need people that understand the whole farming system and where the research fits. Farmers are the best integrators of that.
- We need to move from having solutions and finding problems, to being truly driven by the problem.
- Involving broad key participants and being mindful of getting the right mix of representation. E.g. We often attract those who are "willing" which means we have a bias.
- Considering how research fits into a bigger program of work. Ensure the co-design process is aware of the broader ecosystem.
- Understanding the driver/motivation for change of the end-user.
- Cast a net over a region that has a shared vision - you can get cross-industry, cross-landscape collaboration by biting off a smaller chunk of it.
- Need to think more broadly about who else may also benefit from the solution to this problem. Understand the whole ecosystem and where this fits.
- Need to get accurate validation. What is the standard for validation? Rather than what we've always done.
- Using data to define what problems are.
- Defining the true problem and understanding the user need and validating the need. Practice meets behaviour. Biophysical and social behaviour need to connect.
- Benchmarking plays a role in this - people seeing themselves and where their practices are.
- There are examples of what's working - need to share and communicate that more broadly. Provide tangible examples of where things work - best practice for adoption and RD&E and examples.

Principles

- Engagement continuum with end-users, across all stages. Bring people along with the research process, with frequent feedback to avoid getting lost along the way.
- Collaboration - requires continuous extension. Implications for resourcing. On-going extension strategies.
- Program approach required, with a suite of relevant projects, with a supply chain lens.
 - Meet the needs of each segment of the value chain, including the customer. But be clear which customer we are talking about: the implementer/end-user? or their customer/consumer?
- Opportunity for complete reform of RDCs and research process. Requires buy-in from RDC execs and practical solutions!
- A focus on commercialisation is very useful to keep research targeted on industry needs.

Steps to implement

- Change up the skill sets in research teams. Recognise/ value/ resource the roles of communicators, engagement specialists, social researchers, business strategists.
- RDCs may need to invest in the pre-work of collaborative/ co-design to underpin proposal and budget prep that plans for and provides resources for continued participation of stakeholders in research.
- Empowering researchers to collaborate with end-users.
- Pressure on research sector - lack of available funds/limited budgets. Need recognition of the necessary resources to do research properly.

- Consider extension in project planning and budgeting.
- Maintain research steering committees to meet regularly through the life of the project.
- Scholarships - success planning frequently discussed. Can be supported through internships - but often not taken up.
- Work at school level to start building links between urban students and the rural context.
- When program outcomes are defined; collectively develop the 'adoption/impact pathway' - needs input from many. Identify the gaps in pathway and how to address them.
- Measures (e.g. M&E along the pathway)... to track where critical pieces of the pathway are missing and need to be addressed. Recognise that gaps will impact the success of the system.
- Bring a wider range of skill sets into the RD&E process.
- Invest in training/ professional development for researchers to work in multi-disciplinary teams - recognising this may be a significant cultural shift for many.
- The reward/ recognition feedback for most researchers is individualised. Transition required to reward collaborative teams.
- Increase emphasis/ effort towards connecting research with policy/ strategy/ decision-making.
- Break into manageable chunks.
- Fast fail technique - helps drive the feedback loops and pivots to refine ideas to meet specific needs (or development of solutions that end-users will pay for).
- This approach can be threatening to researchers and RDCs. But we need to encourage a bold shift. Need to think through how to support all to transition.
- Find ways to manage risks (for all - researchers, collaborators, investors). Enable innovation to be trialled at small enough scales.
- Locate the RD&E in the larger ecosystem of change and make sure that the contribution to the desired outcome is located there and transparent what part of the ecosystem it is contributing to.
- Fundamentally its the industry that wants the change.
- Understanding the D&A of collaboration.
 - Goal: Stakeholders can see responsibilities and who is depending on what.
 - Toolbox of adequate pick and choose to articulate. such as workshops, focus groups, literature scans, interviews.
 - Identify openly the people who will use it and their barriers to use resources wisely: not every solution has a problem (segmentation analysis).
- Successful, mutual benefit and collaboration.
 - Be willing and serious to invest resources including paying for end-users time and work. Acknowledgement of other forms.
 - What are (potential barriers) of the collaboration.
 - Develop values and mission.
 - Clarify ownership - doing it for greater good/all stakeholders/community/industry.
 - Identify: what's in for the end-user and beneficiaries, what's in it for me.

- Identify and define the outcomes we are looking for. Which target audience are we working towards and why?
 - Developing a horizontal and vertical strategy to identify and prioritise.
 - Having resources including time available to plan and pre-trial and align the needs.
 - Allow and enforce new communication challenges to target and engage with new end-users rather than the same stakeholders over and over again.
- Principle: be open to learning from every side.
 - Ensure focus groups have the most appropriate mix of stakeholders present.
 - Don't make assumptions.
 - Ensure diversity of stakeholders.
- Principle: Keep extension/ adoption as a key focus in project development.
 - Who? What? How? Support required?
 - Ensure funding body acknowledges importance of adoption and extension activities.
- Principle: Ensure representative groups of end-users.
- Principle: Clearly defined research needs.
 - Accessible to all levels - not just innovators.
- Principle: Really understand change desired by industry.
- Principle: Actively manage D&E with R throughout the life of the project.
 - Go to end-users first.
- Principle: project knowledge and outputs are actively managed - directed towards required industry change.
- Principle: ensure maximum effectiveness of extension activities.
- Principle: ensure impact of project extension activities are evaluated.
 - Use researchers vs. extension specialists strategically.
 - Ensure relevance of messaging.
 - Regular feedback - is this strategy working?
 - Seek feedback from range of levels of involvement in the process/outside the process.
 - Ensure process is adaptive - don't continue if something isn't working - feedback essential.
 - Is the message ready for industry? Do we have all the answers?

Principles

- Revisiting overarching goals and roles of participants.
- Open and sharing with good communication between co-design participants.
- Time for project development, very different to the current model where you might only have 4 weeks to get a project funding application in.
- Be clear on the type of research project and the objectives. If it's applied research, make sure you have appropriate end-users engaged. They could be growers, but also others such as agronomists/advisors.

- Measure.
- Flexible in project delivery e.g. Plan that is adaptable as circumstances change, things change across the 5 years.
- Thinking about outcomes and how they affect the farm business - need to have people with these skills in the co-design team. Issues like risk, magnitude of change, cost, benefits, how you are going to measure this, how certain will you be that the solution will work are key. Researchers must understand the complexity of incorporating the solution into the farming system - work WITH growers on this from the start.

Steps to implement

- APEN contacts established with researchers.
- Need a change in current funding calls.
- Industries sponsor engagement opportunities to bring together a range of stakeholders (outside industries).
- Training in extension.
- Old CRCs enable good collaboration between organisations.
- What's happening outside of Ag and outside of Australia (is this covered in lit review?) in terms of co-design?
- Grower mentors for researchers.

Appendix 8a: Pre-reading material

How can we get greater adoption of the outcomes from RD&E projects? This question has perplexed us for decades, and there's no simple silver bullet to fix it. This is a complex problem, but with your help, we're hoping to develop some useful principles and practical steps that will help improve the impact of RD&E projects.

The project 'Designing the integration of extension into research projects' is being co-funded by eight RDCs and NSW DPI. We're using a co-design process, where with your help, we're trying to better understand the current situation and design a better way of doing RD&E. We don't know the answer yet, but some clues are already emerging from our research. We've identified four emergent themes, as summarised in [Table 3](#).

Table 3: Emerging themes from the research.

Emerging themes / principles	Source
1. Co-innovation/ agricultural innovation system perspective <ul style="list-style-type: none"> • End-users and extension personnel involved in co-designing projects • Involve from the very beginning and throughout 	Literature review Survey data Focus groups
2. Collaboration <ul style="list-style-type: none"> • Include extension thinking • Better engage end-users • Multi-disciplinary teams 	Literature review Survey data Focus groups
3. Evidence driven <ul style="list-style-type: none"> • Farmer-centred design • Use a theory of change • Understand psychological drivers for change 	Literature review Survey data Focus groups
4. Resourcing <ul style="list-style-type: none"> • Longer term funding • Access to extension practitioners and social scientists • Succession planning 	Survey data Focus groups

Theme 1: Co-innovation/ agricultural innovation system perspective

The literature review we conducted showed how our approaches to RD&E have changed over time. Instead of the rather linear models used in the past, we now talk about an **agricultural innovation system**. Here we acknowledge there are multiple stakeholders involved and we need to consider the whole picture with its multiple interconnecting elements. We intuitively know that the more we involve key decision makers in the change process, the greater the ownership they'll have of the resulting outcomes. The online survey data we collected reinforced the need for using a **co-innovation** approach. This involves key stakeholders (including end-users) from the very beginning of the project when they help better define the problem or opportunity. They then contribute to designing the project and help create solutions in collaboration with the other project members. The focus group participants emphasised that **extension practitioners and end-users need to be involved in co-designing projects** from the very beginning.

When we talk about co-design, we mean engaging all the participants equally, so the researchers, extension staff, end-users and other key stakeholders are empowered to make the important decisions collaboratively. You may be familiar with the IAP2 spectrum of public participation ([Figure 25](#)). On the left-hand side we use mechanisms to **inform** the public, like fact sheets and web sites, which basically just tells them what we're going to do. When we **consult**, we use focus groups and surveys to obtain their feedback and we say we'll keep their input in mind when we make the decisions.

When we **involve** them, we can use workshops, and we work with them to ensure their feedback is incorporated. When we **collaborate**, we partner with them and use more participatory approaches to seek their advice, and incorporate that into the decisions. Finally, when we **empower** them, we put the decision making in their hands and we implement those decisions.

Of course, we can use a mix of these approaches in any one project, but when we talk about co-design, we're predominantly using the approaches on the right-hand side—involving, collaborating and empowering the end-users.

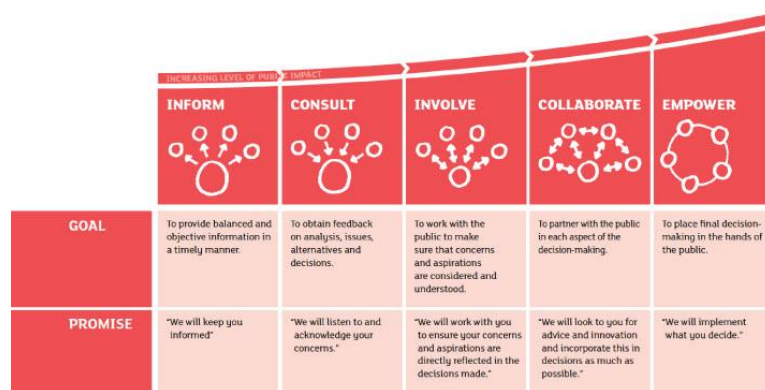


Figure 25. The IAP2 spectrum of public participation.

Theme 2: Collaboration

During the literature review the importance of collaboration was mentioned numerous times. The online survey data echoed this, saying that we need to better **incorporate extension thinking** into the projects, ideally from the project design phase, and stop seeing it as a tack-on activity at the end of projects. Similarly, we need to **better engage stakeholders** throughout the project lifecycle. As we said earlier, greater involvement leads to greater ownership, and of course end-users often contribute great ideas along the way. Focus group participants also discussed the benefits of **multidisciplinary teams**, allowing researchers and others to focus on their strengths.

Theme 3: Evidence driven

The literature highlighted the benefits of being more explicit about the assumptions we make when designing change programs. Some talked about **farmer-centred design** where we start by better understanding the farmer's situation and involving them in the design of the project even before a funding application is submitted. It seems that all too often we jump in, boots and all, thinking we know what's best for the farmer, and are then surprised when they don't rush to adopt the outcomes of our projects.

A **theory of change** is a structured process that allows us to design an adoption pathway by developing a cause-and-effect hypothesis. Working backwards from the desired outcome allows us to identify the outputs and activities required, clarifying the causal pathways and assumptions. The survey data also emphasised the need for better understanding the **psychological drivers** for practice change. This is where we can involve social scientists to help us identify the barriers and enablers of change for our target group.

Theme 4: Resourcing

The results of the survey indicated that if we want greater adoption and impact from the projects, we need to **extend the length of projects**. So instead of traditional three-year projects, five-year ones would allow greater engagement and collaboration. The focus group participants reinforced this, saying the extra engagement and co-innovation takes more time, and so projects with a strong adoption focus should be funded for five years. They also talked about the benefits of having an overarching program focus, with multiple projects contributing to it.

The focus group participants highlighted the lack of resourcing in many existing projects; especially time, budget and the difficulty of **accessing extension practitioners and social scientists**. Similarly, it's challenging to find sufficient numbers of end-users who have suitable experience and time availability. The **need for succession planning** was also discussed. Finally, the importance of building trust with end-users was highlighted, and the need to respect their time.

So those were the four themes that emerged. Going back to the concept of **co-design**, while this is a good principle, it should be applied appropriately; so it's horses for courses. Some projects have a focus where they are extending technologies and practices that have already been developed and used elsewhere, or are required by regulation (e.g. water quality practices). In this case, it is not appropriate to go into a deep co-design activity with users. It may be that such a product easily slips into the new situation, or it may need to be modified, trialled or demonstrated. Likewise, when there is no clear technology, or practice to extend as such, then working at an exploratory level and development of co-design might well be needed.

The model is shown in **Figure 26**, which depicts four different scenarios. Those in the top row don't have their needs or opportunities well defined, and those in quadrant A already have available outputs and solutions, so we need to engage with key stakeholders to explore the usefulness and relevance of the available outputs. For those in quadrant B, there are no ready solutions or outputs, so we need to co-design them with end-users to explore the issues and opportunities, and then develop outputs needed to address the situation.

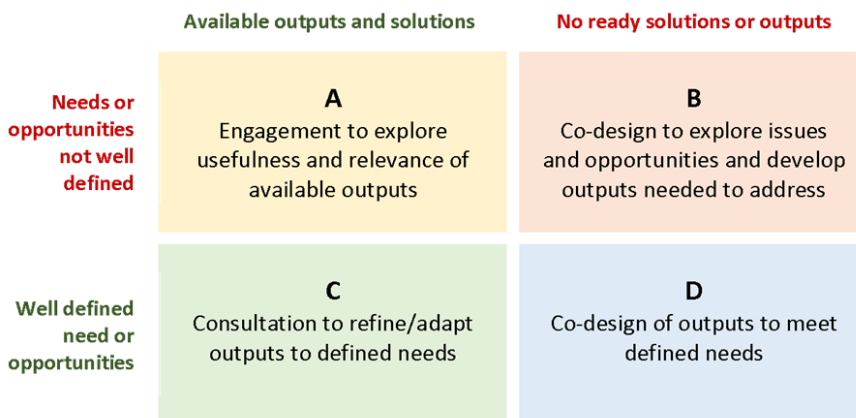


Figure 26. Determining the level of co-design. Source: Coutts 2021.

Those in the bottom row already have well defined needs or opportunities. Projects in quadrant C already have available outputs and solutions, so we need to consult with key stakeholders to refine and adapt the outputs to meet the defined needs. Finally, those in quadrant D don't have ready solutions or outputs, so we need to co-design the outputs to meet the defined needs of the end-users.

Some questions for you to ponder before the co-design workshop

1. As you read through the material...
 - What did you whole-heartedly agree with?
 - What did you disagree with?
 - What is missing (are there areas outside of agriculture that we can learn from)?

2. Regarding the co-design quadrant model...
 - Does it make sense to you?
 - When you consider each quadrant, if we want to achieve greater adoption of the RD&E outcomes for that type of project...
 - What core principles would help it function best?
 - What practical steps are required?

3. What else is required to ensure we achieve greater adoption of RD&E project outcomes? For example, do project proposals need to be changed?

Conclusion

This document summarises the data we've collected to date. Please contact us if you'd like to receive a copy of the following full reports: literature review, online survey and/or focus groups.

We look forward to engaging with you at the forthcoming co-design online workshop, where with your assistance we aim to develop the core principles and practical steps needed to implement these (given that there are a range of project contexts).

Appendix 9: Pre-mortem workshops

1. End-users

Background

A pre-mortem for end-users was conducted on Tuesday 14 June 2022 to help determine potential flaws in the draft principles and steps to integrate extension into RD&E projects.

What went wrong?

The question was asked... “Imagine we’re five years in the future, and we’re discussing the project that was supposed to better integrate extension into research projects. We admit it was a total failure... nothing at all has changed. Researchers are still doing cutting-edge research, but little or none of it is being used by industry. Let’s each answer the question ‘What went wrong?’”

After quietly jotting down their own notes, participants shared their ideas. These ideas were then clustered into the following groups, which were then named accordingly.

Systemic challenges

- Changing geopolitical situation - everything that’s going on in the world - in five years things have changed completely.
- Other systemic issues - other factors within the system meant it wasn’t a priority/ not easily fitting into the system.
- Disconnect between researchers, research managers and the commercial industry – resulting in RD&E focusing on issues other than those that can be commercially adopted by industry. For example, ‘open calls’ often attract researcher priorities rather than industry priorities.

Complexity

- Level of complexity - reading through document requirement for longer lead times. End-users find this hard to imagine... hard to sell to them. So didn’t engage properly/ projects too complex/ fill too many requirements.

R&D resources

- Forced collaboration/ team diverges.
- Team is diverging over the course of the project - could be RDCs, industry or end-user or how the government views funding. People moving apart as they hone in on the end of project because needs are different.
- Fragmentation/ forced collaboration that reverts back - gets pulled apart from outside.
- People will have disconnected through the project.
- Right people to do research in first place/ right people to do right thing (everyone involved).
- Subject specialists trying to push into the extension space (carrying baby too far) - so not having the extension part delivered by extension professionals (as researchers often not endowed with these skills).
- People are moving out of ag research because of the small amount they get paid (in wine struggling to match salaries in research) - so economic viability for themselves.
- Inability to produce true subject matter specialists and end up with generalists!
- Getting balance right between commercial engagement/confidentiality issues.
- Before extension work... really need to collaborate with major integrators - how to do this with confidentiality amongst these.
- Lack of engagement from the get-go, so end up investing in projects that can’t be practically applied at end of project. Need to have a measure of adoption/ application on-farm (rather than publication). But academic career not built on adoption.

Demonstrating value

- What was lacking was demonstrating value, return on investment horizons. Always shied away from that (research science based) but needs more of an economic lens (and communicate that well).

- Haven't really nussed out the value proposition for the work - partly economics but end-users won't do anything if they don't see value. Goes further than economics... need to think a bit deeper about the value proposition (needs to be clearly articulated).

End-user engagement

- Got to continue to work with end-users all the way through - inappropriate or lack of engagement through the process (could be better ways of doing this). It is essential that the end-user of the RD&E recognises the value of outcomes, which is achieved by engaging throughout the whole process and giving them some level of ownership.

Who are we investing for?

- Who are we investing for... those who contribute 80% of production but they are just 20% of all farmers. If you focus on 80% of production, many small farmers will miss out but you've got production on... who do you focus on: the few producing or all? Or is the ultimate focus the consumer? Who are we investing for - consumers, majority producers or all?

Blue sky - not coming up with outcomes that are extendable/ adoptable

- A lot of this work you don't see for 10 years.
- Allocating and funding projects that might be blue sky - strategic on behalf of industry to retain resource for future but may not impact extension now... but need to retain the resource/ support the succession in dept. Not everything will make it through.
- Industry doesn't support the direction that might be going if too much blue sky/ not enough practical outcomes being delivered so lose support base.

Cost

- If costing too much/ economic situation tightening and support base declines/ reduces support for a program.
- Model being proposed is a higher cost model which might attract negativity from those funding research from levy payers or RDCs - has potential for there to be resistance.

Risk mitigation

The participants were then invited to consider ways to mitigate or minimise each group of risks. Again, they worked quietly on their own and then shared their ideas.

R&D resources

- More open-source approach required (open innovation) - a lot of issues come back to confidentiality. Broader sharing required.
- Taking a pathway to adoption approach rather than pre-empting the extension before research is underway.
- Having a skilled project leader - keep the stakeholders engaged, then help align research across many institutions (keeping research institutions engaged). Broaden the people you have involved and have a good program manager.
- Facing the challenge, having centres of excellence - trying to consolidate resources across RDCs (rather than not doing things well).
- R&D funders to better collaborate in terms of resources - perhaps better use of those resources (e.g. sharing social scientists). Pockets of expertise. Greater coordination required and could identify gaps in resource pool (creates challenges with researchers being dragged around).
- Dedicated extension specialists - major hole in wine industry.
- True extension is about tailoring R&D outcomes to fit into an individual business. Trying to extend results at a project level will have limited benefits.
- Making sure that we are embedding early-career development and research - working in one project to allow for next - intergenerational investment.
- Using other skill sets from other pools - comes back to project leader to be able to draw on what might be available.
- Valuing extension - begin with the end in mind, consider extension at the beginning of the conversation so project design captures it.

- Greater coordination and leadership in extension space - no one has led charge to fill gap after reduction in involvement by state departments.

Demonstrating value

- First need to understand priorities - quite a bit of work that goes into R&D priorities but a bit haphazard so a better model.
- Analysis of return on investment - look at return on investment by third party - consideration of this by third party... from inception. Won't work for all projects but will push it forward to maximise contribution to industry.
- Engagement with industry bodies to see into the future so making sure that the study can be applied across whole industry/ everyone has and would like to solve.
- Balance between not just solving problems but addressing barriers to strategic outcomes - articulating clearly where you want to be... getting this balance right. This then creates a different motivation - what would be whole of industry benefit. Having clear understanding of this from the get-go - balance between strategic vs on ground.
- Lack of trust with demonstrating value and some of that comes from a project being funded and pushed through even if not showing results... about when funding allocated how it can be moved especially when not going well.
- Better methodology when defining value proposition.
- Having an understanding of what value looks like - balance scorecard! What's of value and what to measure.
- Demonstrate agility in long-term projects.
- Can we make sure incrementally we can relish the wins and show project is having benefits earlier - points where, if possible, people can show value from project.

End-user engagement

- Engage directly and continuously with those who have identified benefit but also need no voice - define expectations and continually ask if delivering.
- Project leader - must be skilled in being project leader, having training and have some knowledge in industry to drive key industry specialists. Having frequent meetings to keep things moving.
- Way the project is structured - have milestones along journey and these put a link/engagement along the journey (five years is long way to go on a tangent) so putting value on this and getting feedback and letting end-users influence a project. This could avoid the misalignment.
- Improve capacity of end-users to engage in R&D process - improve understanding of process and always same people doing these things so getting more involved.
- Buy-in from multiple end-users. Projects tend to focus/engage with only one or two but getting buy in of more and across the country and collaboration of these end-users throughout project and feeding that into process.
- Not good at reminding people of previous success and use this to inform the future.

Paying end-users for their time

- Define expectations early - need to understand if having a process that requires a lot of time will get people who have a lot of time; if you want people who value their time then need to work that out. Don't necessarily get the best people if you pay. Need better system.
- Could end up paying a lot of people and find a lot won't accept money and do it as part of their job/ or for industry... not convinced everyone needs to get paid but invest money at higher end (i.e. project leads)
- Farmers already work for nothing!
- Ambivalent - could run a trial and see if it delivers value.
- Been on both ends - have love and passion for industry and want to see industry succeed and others just doing a job (this can bring pragmatic approach). How many hours per week/month it will be - and ask people (e.g. 10 hours/month and see what's acceptable).

2. Project Reference Group

Background

A pre-mortem for the Project Reference Group (PRG) was conducted on Wednesday 15 June 2022 to help determine potential flaws in the draft principles and steps to integrate extension into RD&E projects.

What went wrong?

The question was asked... “Imagine we’re 5 years in the future, and we’re discussing the project that was supposed to better integrate extension into research projects. We admit it was a total failure... nothing at all has changed. Researchers are still doing cutting-edge research, but little or none of it is being used by industry. Let’s each answer the question ‘What went wrong?’.

After quietly jotting down their own notes, participants used Padlet to share their ideas. These ideas were then clustered into the following five groups, which were then named accordingly.

1. Ownership at all levels

- No buy in from senior management.
- DP's and RDC staff believe they are already doing it.
- We didn't consider the power relationships, organisations and people with power didn't want to change.
- No changes were made to RDC guidelines.
- No extra resources for user input.
- Users don't see the value or see it as a priority to participate.

2. Process to create solutions

- Our problem definition was slightly off. It wasn't encompassing of the whole adoption complex. Focused on a couple of components only.
- We weren't bold enough. The solutions were only incrementally building on what we currently do. Needed transformative approach.
- Can the fail fast approach happen when the season is only 12 months and may need longer for R&D?
- Corners were cut - said it was done but wasn't.
- The consultation of asking a broad group of people was a great start but thinking of the Henry Ford quote "If I gave them what they wanted I would have built a faster horse". We needed to keep pushing the transformative approach.
- There was not the mental bandwidth in our target audience to consider change.

3. Evaluation and reporting

- Poor feedback loops/evaluation to refine as needed.
- Lack of observability, we couldn't show the change and people couldn't see it.

4. Solutions that didn't gel

- Hard to decide when to use a collaborative process and how much of one and when not to.
- It was all too theoretical, too much intellectual capital required to make it work.

5. Miscellaneous

- Too many people thought this was a complicated problem and co-design was the cause-and-effect solution, when it was complex and we needed to manage emergence with multiple interventions.
- We lost all the key people to other interesting jobs.

Risk mitigation

The participants were then invited to consider ways to mitigate or minimise each risk. Again, they worked quietly on their own and then shared their ideas using Padlet.

Risk 1: Ownership at all levels

- Clear value proposition for senior managers.
- We figured out the value chains, of dollars and careers and status, and made sure solutions dealt with these realities.
- A senior manager acts as the sponsor to pilot/roll this out.
- Co-create across RDCs proposal and reporting pro-formas.
- Middle managers suitably engaged by the senior manager.
- Dedicated effort to identifying and analysing the change management elements associated with this; it will be considerable and wide-ranging.
- Resources and time made available to plan the piloting/ rolling this out.
- Senior manager buy-in is the key. Hate to say it but sometimes the successful implementation of this sort of change is achieved via top-down.
- Engagement plans developed and actioned.
- Senior manager champion to key delivery partners.
- Highlight failures due to lack of collaboration.
- Talk to farmers as to how they want to be engaged.

Risk 2: Process to create solutions

- Pre-mortem is a good start!
- Make time to challenge the process/s, be patient i.e. let's not rush.
- We worked out this is a people thing, not a paper thing. We focused on tacit knowledge rather than explicit knowledge captured on paper and screens.
- Appropriate training and mentoring.

Risk 3: Evaluation and reporting

- Training with suitable resources available.
- Reporting to include process used and how this impacted on outcomes.
- A community of practice allowed visibility and sharing of experiences.
- Engagement and education plans. Again, to date this has worked well but now will only get more complex and harder.
- Using successes of process in communication materials.

Risk 4: Solutions that didn't gel

- Provide case studies of why these approaches work well.
- provide short videos and resources to help people plan appropriately.
- Clear decision tree around horses for courses - and then guides around why and how.
- We didn't bite off too much, we got good at thinking of safe to fail experiments to introduce solutions.
- Address Risk 2 well and Risk 1 is no longer a problem.

Other risks

- We chose to manage risk rather than avoid it, so we went interesting places.

Further comments

In the ensuing discussion, the following points were mentioned.

- Practical concerns engaging with industry and team.
- Shifting blame and responsibility - who owns the need for research to have impact (researchers say it's the extension team...). How to manage blame shifting when things don't go quite right.
- Co-design process should work through where roles and responsibilities lie. Levers - dollars, careers, status - need to pull or acknowledge.
- No one owns the symphony but everyone comes in at the right time - need to have the plan for this. Recognition that I don't just play oboe but I play in the symphony.
- Growing disconnect between levy payers outsourcing R&D to RDCs and their own business R&D.
- If going to pay only a few people to be on a panel - it's a dilution so are there ways of being able to incentivise growers taking part in setting R&D focus. Could they perhaps get a discount on their levy payment?

Appendix 9a: Pre-reading material

How can we get greater adoption of the outcomes from RD&E projects? Spoiler alert: there is no single, silver bullet to fix this age-old dilemma. This is a complex problem, as cause and effect relationships are often only obvious in hindsight, and there are often unpredictable, emergent outcomes. However, as a result of engaging with over 300 professionals working in agricultural RD&E across Australia, we’ve distilled a list of key principles and practical steps that can help improve the impact of RD&E projects.

Key principles

1. We need to use a **systems perspective** as we’re working in an Agricultural Innovation System where many of the elements are interconnected and where feedback loops are important. The biophysical elements and human behaviour need to connect.
2. We’re predominantly working with the **humans** in the system, even if we’re studying the plants or animals. So, using **human-centred design** principles are important. This is similar to the farmer-first approach but is wider to include all key stakeholders. **Design thinking** is a human-centred approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success. See **Appendix 1** for a more detailed explanation of design thinking.
3. **Involving end-users** (and other key stakeholders) throughout the project (ideally prior to writing a funding application) not only allows them to contribute their often-brilliant ideas, but it provides greater ownership of the outcomes. The overall collaborative project process involves co-design, co-creation, co-implementation and co-evaluation, as shown in **Figure 27**.

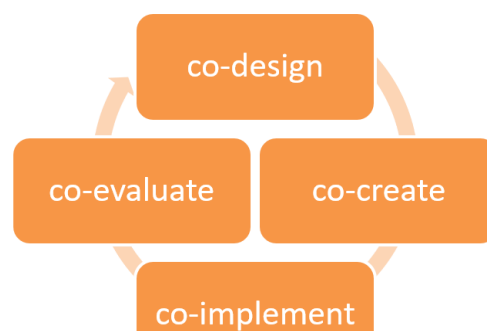


Figure 27. Collaborative project methodology.

When we talk about **co-design**, we mean engaging all the participants equally, so the researchers, extension practitioners, end-users and other key stakeholders are all empowered to make the important decisions collaboratively. You may be familiar with the IAP2 spectrum of public participation (see **Figure 28**). On the left-hand side we use mechanisms to **inform** the public, like factsheets and websites, which basically just tells them what we’re going to do. When we **consult**, we use focus groups and surveys to obtain their feedback and we say we’ll keep their input in mind when we make the decisions. When we **involve** them, we can use workshops, and we work with them to ensure their feedback is incorporated. When we **collaborate**, we partner with them and use more participatory approaches to seek their advice, and incorporate that into the decisions. Finally, when we **empower** them, we put the decision making in their hands and we implement those decisions.

Often we’d use a mix of these approaches in a project, but when we talk about co-design, we’re predominantly using the approaches on the right-hand side—involving, collaborating and empowering the end-users.

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
GOAL	To provide balanced and objective information in a timely manner.	To obtain feedback on analysis, issues, alternatives and decisions.	To work with the public to make sure that concerns and aspirations are considered and understood.	To partner with the public in each aspect of the decision-making.	To place final decision-making in the hands of the public.
PROMISE	"We will keep you informed"	"We will listen to and acknowledge your concerns."	"We will work with you to ensure your concerns and aspirations are directly reflected in the decisions made."	"We will look to you for advice and innovation and incorporate this in decisions as much as possible."	"We will implement what you decide."

Figure 28. The IAP2 spectrum of public participation.

4. The **appropriate level of co-design** needs to be assessed, as not all projects will require the same amount. See **Appendix 2** for a discussion about the co-design quadrant.
5. **Design for impact**. We’re often good at planning and implementing projects, but we need to spend more time designing them for success—in this case, the adoption of R&D. To achieve this, we can use design thinking, building a theory of change, and understanding the psychological drivers for change. See **Appendix 3** for a detailed explanation of how to build a theory of change.

6. When appropriate, **agile project management** approaches enable a collaborative approach, allowing end-users to provide feedback throughout the process. It increases flexibility, allowing the team to more easily adapt to change and minimise risk by failing-fast. See **Appendix 4** for more details.

Potential implications for project funders

There are some implications for project funders as they explore how to embed these principles in practice, as follows.

1. RDC request for proposals (RFPs) will need to provide much **longer lead times**, to allow potential project teams to collaborate and develop viable proposals. Projects requiring significant end-user engagement and adoption may require five-year timeframes.
2. **Project documentation** (e.g. RFPs and application templates) will need to include suitable questions about the proposed co-design process to ensure appropriate processes and levels of collaboration are incorporated. Milestones should be compatible with an agile project management approach, with appropriate stop/go clauses to minimise risk.
3. **Capacity building** of RDC program managers in the areas of contemporary project management and extension may be required.
4. **Adequate resourcing** will be needed to enable inter-disciplinary teams to focus on the problem/ opportunity with sufficient time to engage and learn with end-users (and other key stakeholders). Team members should be representative and might include researchers, extension practitioners, engagement specialists, communicators, social scientists and end-users. It is worth taking the time to get the right people with the right skills involved. Of course, the more people that are involved, the greater the time it will take to come to consensus when making decisions.
5. **Remuneration for end-users**. Due to the greater level of involvement, end-users should be appropriately remunerated for their time. This would recognise the value they provide, and that being involved takes them away from their day-to-day role, which is generally their main source of income. Being able to compensate them for their time will help ensure continuity of involvement as well.

Practical steps for the project team

Here are some suggested practical steps for the project team, listed as bullet points for each principle.

Systems perspective. We're working in an Agricultural Innovation System where many of the elements are interconnected and where feedback loops are important.

- Project clearly aligns with industry priorities.
- Project goals link clearly to the results of a needs analysis process.
- Industry stakeholders kept informed and updated with responses to feedback provided.

Human-centred design. Design thinking is a human-centred approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success.

- Use the design thinking process: empathise, define, ideate, prototype and test.
- Build a theory of change.
- Capacity building of project team members in the appropriate use of human-centred design approaches may be required.

Involve end-users. Involving end-users (and other key stakeholders) throughout the project allows them to contribute ideas and creates greater ownership of the outcomes.

- Identify and engage suitable end-users (and other key stakeholders) early and throughout the life of the project.
- Users are explicitly engaged to provide input into the design of outputs and/or extension process.
- Users test and provide feedback at all stages of developing and finalising outputs.
- Those who provide feedback are themselves given feedback about how their input impacted the final product.
- The broader stakeholder/user community is kept abreast of the design and testing process.
- There is a specific communication and engagement plan which allows for two-way communication.
- Stakeholders and users provide input into the plans.
- The capacity of the end-users involved in the process is invested in and built over time.

- There is collaboration and coordination with other programs/ organisations delivering in the same area/ topics to maximise synergies.
- Good extension processes are used, with a mix of methods appropriate to the project and its context.
- Peer-to-peer approaches are used to maximise exposure, sharing and confidence.
- Demonstrations are used, on commercial farms when possible.

Level of co-design required. The appropriate level of co-design needs to be assessed, as not all projects will require the same amount of co-design.

- The value proposition is high, clearly articulated, barriers understood and addressed.
- The innovative practice is easily trialled at a level which can be reversed if needed.
- The innovative practice is not complex – and/or effort is made to simplify packages and processes to aid in integrating into current farming systems.
- Capacity building of project team members in co-design and contemporary extension approaches may be required.

Design for impact. Spend more time designing them for success. Success is defined as adoption of R&D.

- Transparent research process with good scientific method.
- Plans, processes and outputs reviewed by specialists outside of project team.
- Scientific papers and other publications detail the method and include references.
- Real-time evaluation is used to capture reactions and impacts, and guide adaptive management.
- Capacity building of project team members in using a theory of change may be required.

Agile project management. These flexible approaches enable a collaborative approach, allowing end-users to provide feedback throughout the process. It increases flexibility, allowing the team to more easily adapt to change and minimise risk by failing-fast.

- There is collaboration and coordination with other programs/ organisations delivering in the same area/topics to maximise synergies.
- Good extension processes are used with a mix of methods appropriate to the project and its context.
- Real-time evaluation is used to capture reactions and impacts and guide adaptive management.
- Capacity building of project team members in contemporary project management may be required.

Appendix 9a (i): Design thinking

Design thinking involves five steps: empathise, define, ideate, prototype and test. It is an iterative process, as shown in **Figure 29**.

1. **Empathise:** develop a deep understanding of the needs of the target audience and their situation through empathy-based interviews or observations.
2. **Define:** clarify the problem by challenging assumptions and potentially reframing the question, to clearly define the right problem to be solved.
3. **Ideate:** generate a large number of ideas related to potential solutions.
4. **Prototype:** identifying possible solutions to progress and creating low fidelity prototypes so audience members can preview the experience.
5. **Test:** taking prototypes into the field to better understand audience needs and further inform and iterate the solution.

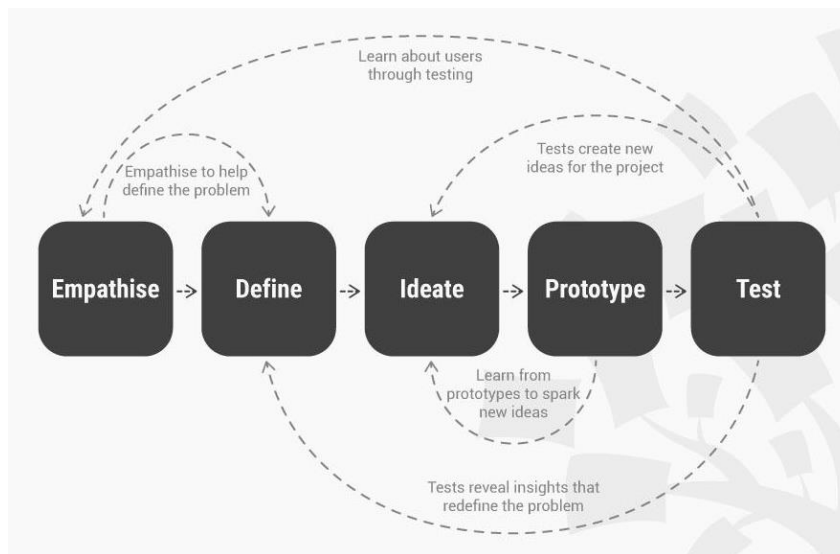


Figure 29. The iterative process of design thinking. Source: www.interaction-design.org

A similar approach is the double diamond process, popularised by the British Design Council. This approach uses the processes of divergence and convergence to ‘design the right thing’ and then ‘design things right’, as shown in **Figure 30**.

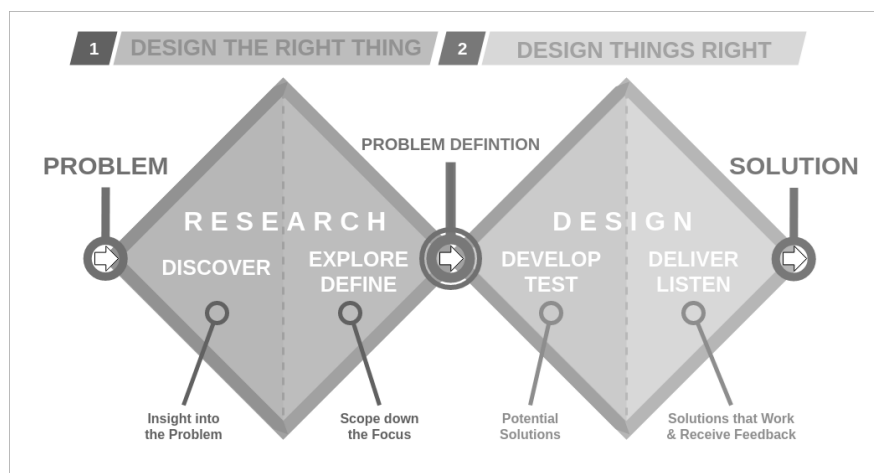


Figure 30. The double diamond process. Source: Digi-ark

Appendix 9a (ii): Co-design quadrant

While co-design is a good principle, it should be applied appropriately; so it's horses for courses. Some projects have a focus where they are extending technologies and practices that have already been developed and used elsewhere, or are required by regulation (e.g. water quality practices). In this case, it is not appropriate to go into a deep co-design activity with users. It may be that such a product easily slips into the new situation, or it may need to be modified, trialled or demonstrated. Likewise, when there is no clear technology, or practice to extend as such, then working at an exploratory level and development of co-design might well be needed.

The model is shown in **Figure 31**, which depicts four different scenarios. Those in the top row don't have their needs or opportunities well defined, and those in quadrant A already have available outputs and solutions, so we need to engage with key stakeholders to explore the usefulness and relevance of the available outputs. For those in quadrant B, there are no ready solutions or outputs, so we need to co-design them with end-users to explore the issues and opportunities, and then develop outputs needed to address the situation.

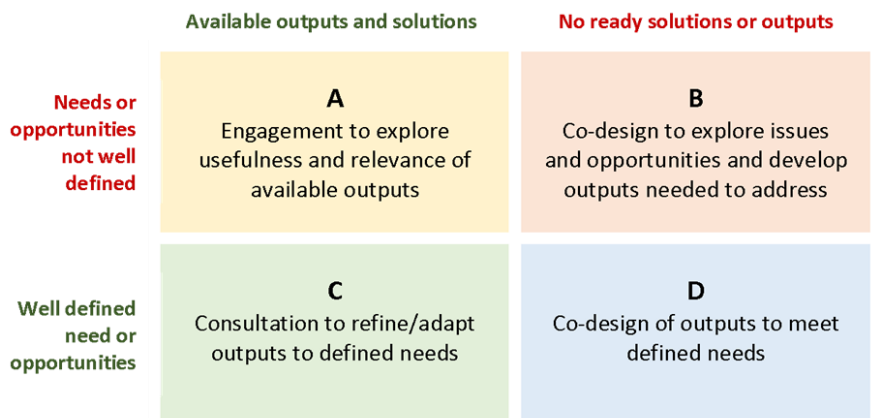


Figure 31. Determining the level of co-design. Source: Coutts, 2021.

Those in the bottom row already have well defined needs or opportunities. Projects in quadrant C already have available outputs and solutions, so we need to consult with key stakeholders to refine and adapt the outputs to meet the defined needs. Finally, those in quadrant D don't have ready solutions or outputs, so we need to co-design the outputs to meet the defined needs of the end-users.

Appendix 9a (iii): Theory of change

A Theory of change (also known as program logic, impact pathway, causal model, and intervention logic), is a process that focuses on how a project plans to achieve change by making the underlying assumptions explicit. Traditional project planning focuses on what needs to be done by when and to what standard. Developing a theory of change helps us work through why we are choosing particular interventions and the logic behind those choices. This can be displayed graphically, as shown in **Figure 32**.

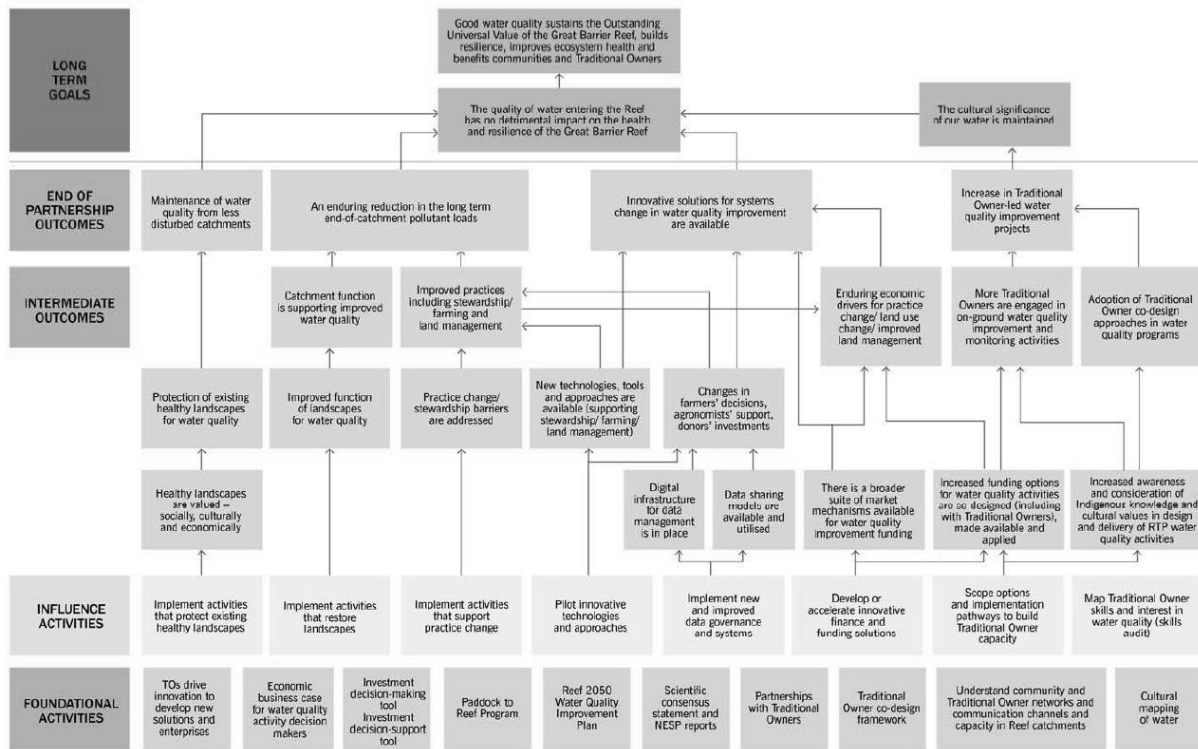


Figure 32. An example program logic for reef water quality. Source: Reef Trust Partnership (2019).

While useful in designing projects, it is equally useful for subsequently planning, implementing, and evaluating the project. Beginning with a program logic based on a system understanding is particularly useful, as it can help connect the high-level strategy with what is actually happening on the ground. It is important that team members and stakeholders are given the opportunity to contribute to the program logic, as that will entrust them with greater ownership.

There are generally 10 steps, grouped into the three phases of situation analysis, theory of change, and assumptions, as shown in **Figure 33**.

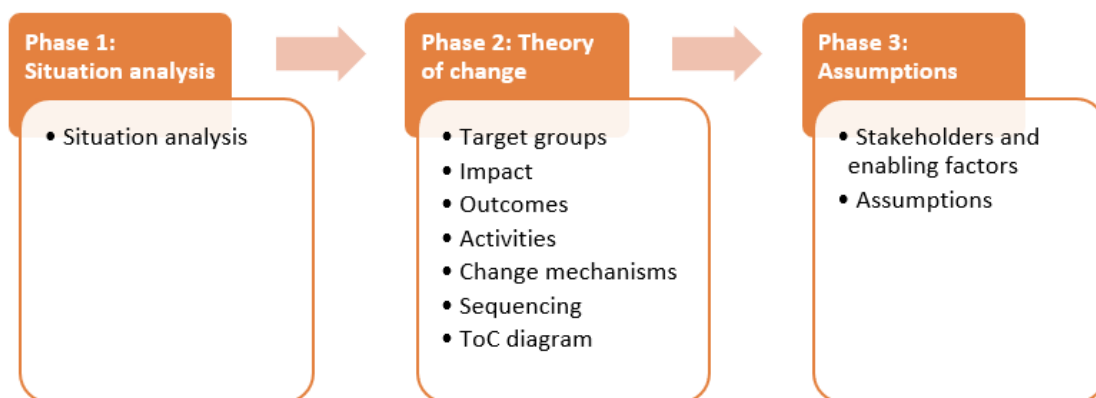


Figure 33. The phases and steps involved in building a theory of change.

Phase 1: Situation analysis

The situation analysis encourages us to take a step back, allowing us to define and explore the problem or opportunity that we are focusing on. We examine its causes, the context and the systems we are working in, and the resources available.

Step 1: Situation analysis

Develop a brief problem/opportunity statement in just one or two sentences. This helps us and others more clearly understand it. The sharper and narrower we can make this statement, the better. Consider questions such as: who is affected, what are the consequences of inaction, what might be causing the problem, what might some barriers to change be, how might these barriers be overcome, who else is working in this area?

Then consider the resources we have available and what we can contribute. Consider questions such as: what existing resources are available (including experience, reputation, connections, expertise, and funding). Who might collaborate with us and what would they bring to the table? What are the high priority areas to focus on, and which are the lower ones? What approaches would we rule out and why?

Phase 2: Theory of change

Clearly define our target groups. Who are the people or institutions you aim to work with, and what are their characteristics and needs? Then define the sustained impact we strive to achieve for each of the target groups. Next, working backwards, define the shorter-term outcomes we think are needed to make this impact. Then define activities and mechanisms that we think will make the outcomes more likely. Finally, consider the sequence in which the change might occur and summarise it in a diagram.

Step 2: Target groups

Describe the types of people we want to work with directly. These are the ones we plan to focus on, even though there will probably be flow on effects to other groups as a result. Describe the target group in a short phrase or sentence. Then consider the characteristics of the target groups including both objective factors (e.g., age, location, education, and personal histories) and subjective factors (e.g., knowledge, attitudes and behaviours).

Step 3: Impact

Describe what the project hopes to achieve in the long term. Consider what we want the sustained effect on each target group or the environment to be. Think in terms of three-to-five-year horizons and the effect we would hope to see by then. Create some short impact statements that capture the desired impact.

Step 4: Outcomes

Define the outcomes which will contribute to the desired impacts. How will the situation or target groups be different in the shorter term? For our target group, what changes in knowledge, skills, attitudes or behaviours do we hope to see achieved?

Step 5: Activities

Identify the activities we will need to do to achieve those outcomes, but there is no need to go into too much detail at this stage. What will the activities look like and who will deliver them? How could people find out about the activities?

Step 6: Change mechanisms

Describe how we want the people to engage with your activities, or experience them, to make the outcomes more likely and impactful. This could be merely stating that people need to understand our advice to make a change, or it can be more subtle, such as they need to believe our advice is relevant to them and believe they can take action on it.

These should be made explicit, and defining mechanisms can be one of the hardest parts of the process. However, it is

also the most useful. It is in this step we focus on how our work is intended to achieve change. Consider what will make the activities particularly effective, what is unique about our services, and what are the qualities that our staff or volunteers will need to exhibit.

Step 7: Sequencing

Consider the order that the outcomes and impact might occur in and stages in which it might happen. Think about how we expect the change to happen and what your contribution might be. In this step we might identify gaps in our reasoning or realise that some activities are more applicable to different stages. For long-term projects, this can help us set more intermediate objectives and early indicators of success. This step is about identifying a broad logical pattern, even though in reality we know that people will move back and forth, jumping from one stage to another.

Step 8: Theory of change diagram

Drawing a visual representation of our program logic helps us to be more succinct and possibly see new connections or spot some gaps. It is also a useful communication tool for sharing our plan with others.

Phase 3: Assumptions

The final phase encourages us to think again about how your external context might influence our theory of change and what the weaknesses or assumptions may be.

Step 9: Stakeholders and enabling factors

What do we need other stakeholders or collaborators to do (or not do) to support our theory of change? What factors outside our control might affect your theory of change? What other contextual conditions might affect our theory of change?

Step 10: Assumptions

Identify the places where our theory of change is weak, untested, or uncertain. This helps clarify our biggest concerns and helps us identify our main research questions. Consider what our fiercest critic might say about the plan. What would they say the weakest part of it is and why? Why might people say our project will not make a difference? What are some possible unintended consequences?

It is important to note that the resulting program logic needs to be adaptable and able to respond to change, subsequent interventions, and possible changes in objectives. This will enable the project team to be flexible and use the principles of adaptive management to steer the project towards the desired outcomes, despite changes occurring in the internal and external environments.

Appendix 9a (iv): Agile project management

Traditional waterfall project management uses a pre-determined, linear, sequential approach to execute a project. The final result is often only shown to the end-users once the project has been completed. In contrast, agile project methodology is iterative, using short cycles of work, and a series of continuous releases which allows end-user feedback throughout the process. This collaborative approach usually results in a series of quicker, smaller results, which are more aligned to end-user needs. This reduces the risk of developing a solution that is not widely adopted by industry. A visual comparison of the two approaches is shown in **Figure 34**.

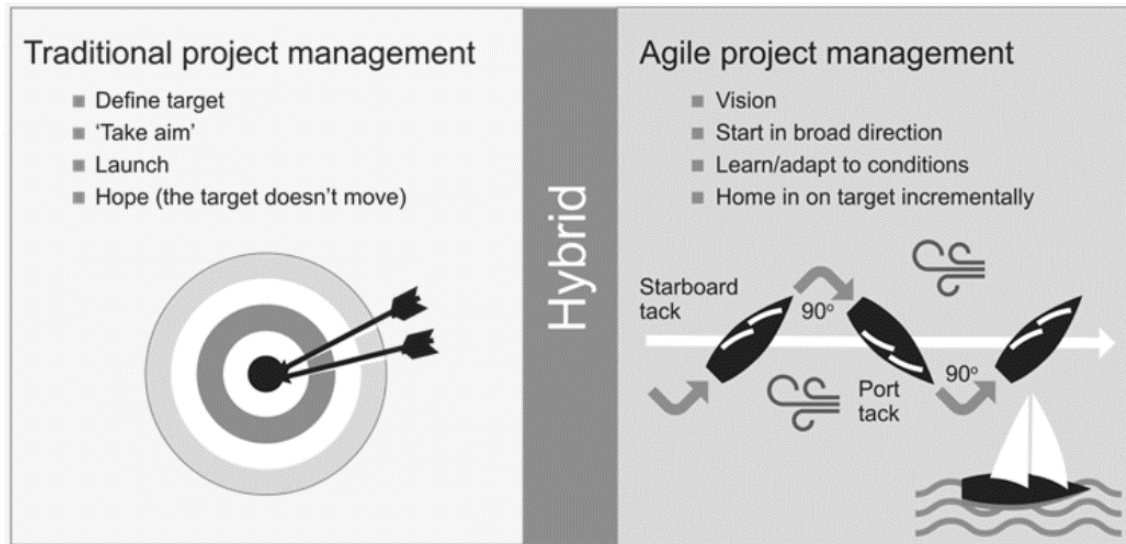


Figure 34. Traditional versus agile project management. Source: www.apm.org.uk

The following values characterise agile methodologies:

- personal relationships over processes,
- authenticity and accountability over polish and promises,
- collaboration over competition, and
- responding to change over following a plan.

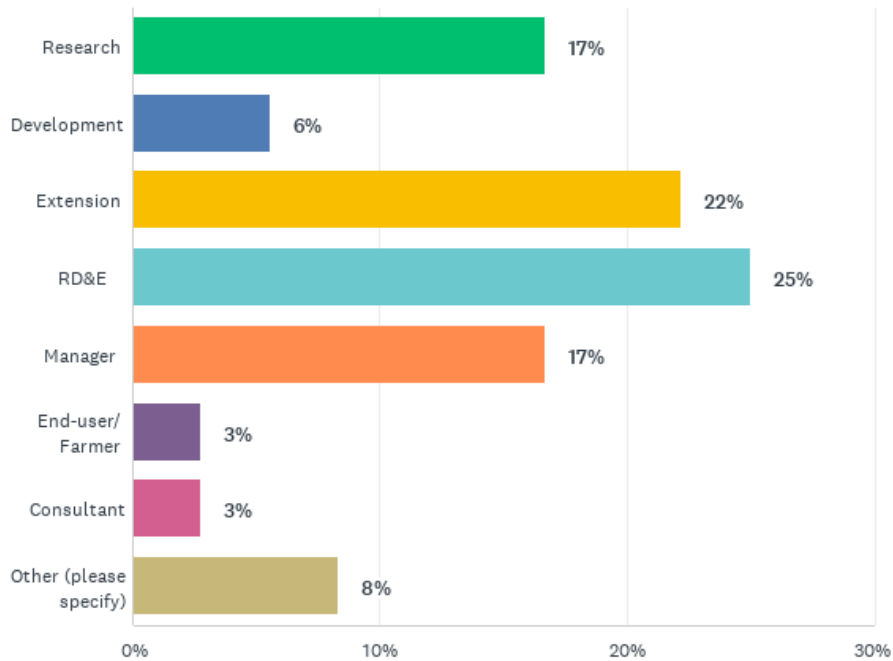
While there are multiple types of agile project management, one of the most popular ones is called Scrum. It uses short iterations of work, known as sprints. Often a sprint is three to six weeks in duration and a planning meeting occurs at the beginning. Daily scrum meetings (often just 15 minutes in duration) then help the team stay focused and report on progress and any new risks identified. At the end of the sprint, a review meeting assesses the performance and informs the next sprint.

There are three key roles in a scrum team: scrum master, product owner, and development team. The scrum master facilitates the overall process, while the product owner is responsible for ensuring the end-users' needs are correctly met. The development team undertakes the work and is usually interdisciplinary.

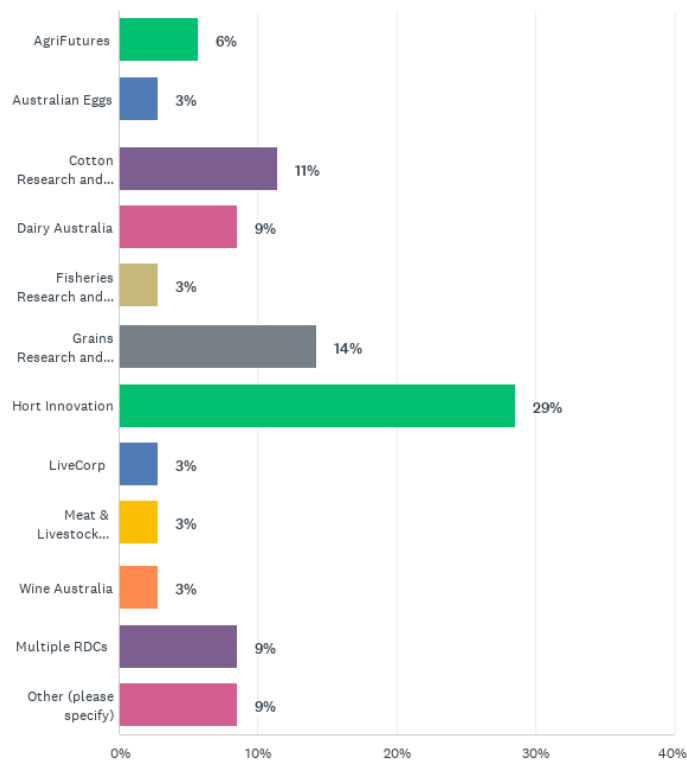
Appendix 10: Participant evaluation

All those who participated in the project were invited to complete a short survey. After eliminating duplicates, a total of 197 invitations were distributed.

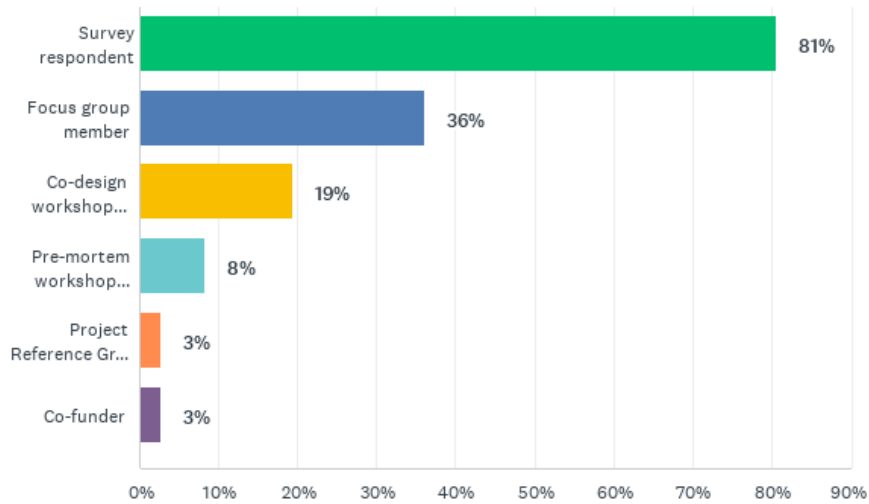
The majority of the 38 respondents identified their role as research (17%), development (6%), extension (23%) and RD&E (26%). Other roles included manager (14%), and a small number of end-users and consultants (3% each).



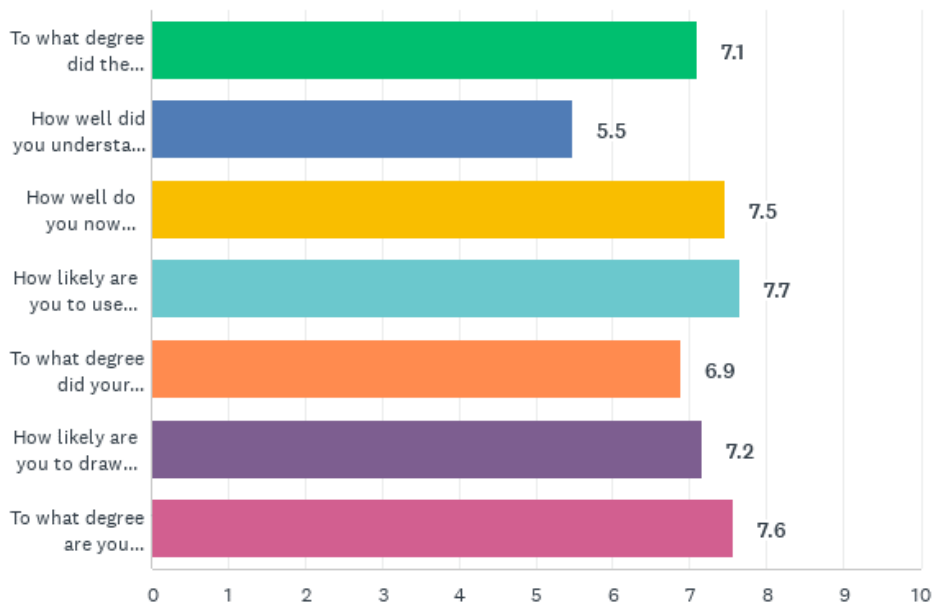
Regarding the RDC or associated industry, respondents represented 10 of the 15 RDCs, with Hort Innovation having the greatest representation (29%).



When asked to identify their involvement in the project, the greatest number of respondents indicated they were a survey respondent (81%), followed by focus group participant (36%) followed by co-design workshop participant (19%).



When asked to rate (on a 10-point scale where 1 is low and 10 is high) the degree to which the co-design process allowed them to contribute to the outcomes, the mean was 7.1. Their understanding of the co-design process beforehand was 5.5 and increased to 7.5 after their involvement with the project. When asked how likely they were to use a co-design process in their work going forward, an average rating of 7.7 was provided. When asked to what degree did their involvement help their thinking and understanding around how to more effectively include extension in projects for better outcomes, an average score of 6.9 was provided. When asked how likely they would draw from the findings of this project to inform the way they might seek greater impacts from projects, an average rating of 7.2 was provided. Finally, when asked their level of satisfaction with their level of involvement in the project, an average score of 7.6 was provided.



In the final comments section, several respondents indicated that they were keen to receive the final report so as to read the recommendations. Others expressed their hope that the outcomes of this project will be used and embedded in RDCs.