Online Farm Trials (OFT) Impact Research:

eResearch (First Wave) Extended Timeframe Research Study

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Executive Summary

Background and the imperative for research

Online Farm Trials (OFT) is an eResearch innovation that has been operating since 2013 and was developed for implementation by the Centre for eResearch and Digital Innovation (CeRDI) at Federation University Australia. Online Farm Trials (OFT) is headed up by a team of CeRDI senior scientists, researchers and programmers, with additional field expertise drawn from external agriculturalists. The underpinning principle of OFT is to help improve the productivity and sustainability of farming enterprises by improving access to trial research information. The OFT project achieves this through two online research applications, the Trial Explorer and the Report Library.

The Trial Explorer allows users to search and filter farm trial projects from across the country to provide targeted results before giving users the opportunity to view, share and export the information. The Trial Browser, a subsidiary tool of the Trial Explorer, provides users with the opportunity to browse trial projects in areas where slow speeds restrict internet access. A Report Library gives users the ability to search an online repository of grains industry research documents such as trial reports, case studies and project summaries for further information regarding their area of interest.

Technological innovations, such as that represented by OFT, need to be examined within the context of their capacity to shift traditional approaches to knowledge building and practice management. In order to determine the impact of OFT on decision making, information and knowledge building, a structured and sustained program of research became a key imperative. The areas which were assessed as being of particular importance in building insights into the potential of OFT to achieve the underpinning principle for which it was established were:

1. Implementation issues encountered as part of roll out of the program;
2. Barriers and enablers to uptake;
3. The impact of online trials on factors such as
    a. decision making;
    b. farm development and environmental management processes;
    c. enterprise enhancement;
    d. issues of intergenerational change and decision support techniques; and,
    e. overall practice change.

In order to build an evidence base around these issues, a detailed study design was developed, linked closely to a review of available literature of relevance.

Literature review

The literature process provided valuable insights into a range of factors of relevance to building a stronger understanding of the impact of a range of factors on the uptake of technological innovation. These insights related to:

1. Farm decision making processes
2. Information access and knowledge building within the context of agriculture
3. Technology and farming

A detailed overview of all these themes is provided in the body of this report (Section 2)

Farm Decision Making Processes

There was a consistent message throughout the literature that, the establishment of a technological innovation, even one that is responding to an identified need, and accommodating a sought for change, is not a sufficient determinant of uptake of innovation. There are a broad range of internal and external factors that shape and define decision making, particularly as it relates to technological innovation. These include:

- Personality types.

- Individual learning styles.
- Value bases.
- Personal goals generally and personal goals as they relate to the farming enterprise.
- Peer, professional, industry and community networks.
- Level of trust within the context of the network.
- Levels of risk potential as a result of the change process.
- Levels of risk resultant from the social, economic and political environment.
- The contemporary social, economic and political environment.
- Locational factors; what is happening within the context of community, geography and social norms.

Closely linked to the process of farm decision making is that of how key stakeholders, particularly farmers and consultants, access information and effectively achieve knowledge transfer as it relates to technological innovation.

Information access and knowledge building within the context of agriculture

The literature in this section has captured some key factors pivotal in building understanding of how to increase information access and knowledge building for the agricultural sector. A summary of the key points of relevance to this research study show:

- The provision of adequate information is critical for the support of informed decision making and the attainment of best outcomes. Within this context, technology provides an innovative means for increasing the capacity for accessing information, for the transfer of knowledge and for enabling individuals to retain higher levels of control over the knowledge building and decision making process.

- Lack of information disadvantages decision making through:
    - Reducing capacity to build a greater level of understanding of research driven industry best practice.
    - Removing levels of autonomy in a rapidly growing era of knowledge building.
    - Limiting understand of the value of technological innovation and, linked to this, limited adoption of innovation and change with the potential to enhance practice outcomes.

- A number of strategies have been found to be particularly valuable in driving and supporting changes in behaviour and attitudes as they relate to technology, information access and knowledge transfer. These are:
    - Providing information that is of a high quality.
    - Ensuring that content is updated on a regular basis, is easily accessible and has high levels of flexibility and reliability.
    - Ensuring that delivery techniques are user friendly and relevant. This needs to occur from the outset for effective engagement to occur. Reengagement with an innovation, once an initial introduction has occurred and there has been a failure in capturing the audience, is very difficult to achieve.
    - Working closely with end users to ensure that they are active participants in innovation development, and in the process of implementation, review and expansion. This will enable the retention of control over the knowledge building process – an important part of stakeholder identity.
    - Ensuring that the information provided has local relevance and applicability, and that innovations are closely aligned to sector priorities and industry imperatives, with overt and observable advantages to uptake.
    - Developing a resource that uses plain language and graspable concepts. Academic language, complex scientific concepts and the lack of a clear link between theory and practice will all act as barriers to uptake.

- The provision of education (not formal/tertiary level) is an effective strategy for skill building which will support and facilitate access. For this to be successful, the skills training provided must:
    - Adopt a social learning approach in which networks and peer relationships are used to highlight the potential of technological innovation and to share successful experiences as they relate to implementation, impact and outcome.
    - Be underpinned by a capacity building agenda – focusing on effective and applied learning so that skills that are learned are transferable across different types of technology and different priority enterprise issues. This training should be characterised by high levels of interactivity.

- At the centre of this capacity building process should be the identification of champions to promote and advocate for the uptake of the innovation. These champions need to be drawn from the relevant web of influence of the potential end users. These are people who are trusted, respected within their sector and have used the innovation successfully – or who can advocate for the potential of the innovation to achieve positive and sector enhancing outcomes. Closely linked to the building of innovation champions is building connection with the innovation developers (the researchers). A strong link between innovation developers and end users helps to create a place in the market, and an increased understanding of its potential for the practice setting.

Technology and Farming

In regard to the literature on technology in farming, the key emergent themes that were drawn from previous studies were that:

- Level of education and socioeconomic status play a role in determining levels of familiarity, competence, use and uptake of technology
- Those with greater economic security are more likely to better understand the potential of technology to enhance returns. Correspondingly they are likely to be more flexible in the timeframe they allow for economic return from technological investment.
- Younger farmers have been found to be more likely to try technology, and feel comfortable in its use. They are also more likely to make the conceptual link between competency in the use of technology and the achievement of greater levels of success in the application of technological innovation as an integral part of the decision making process.
- Internet access remains a major issue in rural and regional communities, while problematic, access is secondary to skill in the use of technology. If you have no access then you might still have the skills to effectively use technology (when available). If you have no skill base then material access becomes a secondary issue. Effective access is a good start but, for those who do not have confidence in the use of technology due to age, levels of education or socio economic status, it is not the ultimate determinant of uptake.
- Age influences learning styles, and responsiveness to becoming involved in training regimes. This subsequently impacts on building skill development in the use of technology for some in the agricultural sector.
- Social and interactive learning technique provide a proven approach for skill building in the use and the application of technology for farm practice and decision making.
- Women in agriculture have higher levels of skill in technology and in the application of technological innovation. Within this context they provide a valuable resource for supporting uptake.
- There needs to be a strong alignment between the claims of technology and its demonstrable capabilities. Any gap between what is claimed, and what is delivered, will diminish levels of uptake of technology to access contemporary innovation. This is likely to be particularly problematic when skills in the use of technology are low.
- Assessment of shortfalls in the technology are usually related to: how easy it is to navigate through the technology to find specific answers; how useful these insights are perceived to be for improving farming outcomes; whether it is possible to answer research questions and build knowledge about priority issues within a particular catchment; and, whether the technology will provide viable solutions to address priority issues for the community that is accessing it. If these factors are addressed, many of the barriers to the uptake of technology are likely to be diminished.

Study design

The research approach developed for the study, based on issues tracked through the literature review, and the subsequently identified knowledge gaps, adopts an interpretative research logic. The need for this approach aligns closely with the global call for both quantitative and qualitative evidence for measuring impact of technological innovation. This approach will allow individual stories and experiences to be collected and this narrative will increase capacity to identify the stories behind the impact of technology and innovation on decision making, and on practice approaches.

The research design strategy applied for this research is a case study approach; examining OFT as a single case with multiple levels of analysis including grower groups, GRDC panels, growers, agricultural consultants and researchers.

Data for this study was collected nationally, from all states of Australia from which farm trial data has been collected. Research will occur in a series of 4 data collection waves to allow comparative data to be gathered and for this to occur across a longer timeframe.

Data collection will occur in the following sequence:

1) Wave One - At early implementation (this current study);
2) Wave Two - 12 months after completion of Wave One;
3) Wave Three - 24 months after completion of Wave One (12 months after completion of Wave Two); and
4) Wave Four - 36 months after completion of Wave One (12 months after completion of Wave Three).

The entire research study, through incorporating all data collection waves, will take 48 months to complete while data collection for each of the data collection waves comprises:

- An online survey;
- Interviews with identified key stakeholders including researchers within the crop research space;
- Portal usage data usage analysis (Google Analytics); and
- Document analysis.

Data will be analysed using established techniques for qualitative and quantitative data analysis including coding, the use of Excel, SPSS and Nvivo.

Data validity and generalisability will be achieved through the use of triangulation of methods, source and design. In addition to maximising data validity these triangulation techniques will ensure a strong body of primary data from which to draw conclusions relating to the implementation and impact of OFT.

The analysis for this research will, across the completion of the four waves of research, be on the impact of the innovation in terms of knowledge, behaviour and attitudes. The study will measure levels of knowledge held amongst study participants as it relates to OFT, whether there have been decision making behaviour changes over time as a result of OFT and whether attitudes have changed over time so that OFT is viewed as an integral part of the decision making and practice support system for end users. To support the data collection process, five overarching general research questions have been developed, each supported and consolidated through a range of subsidiary questions.

1. What strategies in implementation of Online Farm Trials have worked most effectively to support and facilitate data access to the maximum numbers of potential end users?

2. What approaches applied during the eResearch relationship were found to maximise stakeholder input to the knowledge building process?

3. What have been the key impacts of Online Farm Trials for a range of key stakeholders, including growers, farming groups, researchers and agronomists?

4. How have Online Farm Trials effectively captured data that can be used to build evidence based knowledge repositories to maximise access and minimise research duplication over the longer term?

5. In what ways does open data access, as provided through the tools and mechanisms of eResearch, impact on decision making and facilitate practice change?

A research typology has also been developed to determine the extent to which a particular initiative is having an impact, at a range of levels, for the end users of the technological innovation under examination. The typology also facilitates the measurement of the extent to which an initiative is achieving the purpose for which it was established.

Level 1: The *Primary Impact* level. This refers to emerging insights and trends relating to the innovation. Attainment of this level is commonly determined by analysis of usage levels and participant feedback about data currency, quality and relevance. It is also related to user type and the reasons.

Level 2: The *Practice Impact* level is based on the extent to which the technological innovation is being utilised within the industry, sector, community and/or workplace to aid in decision making, to exchange information and knowledge and to shift perceptions. At this level shifts impact measurement to a higher order than that measured with Level 1.

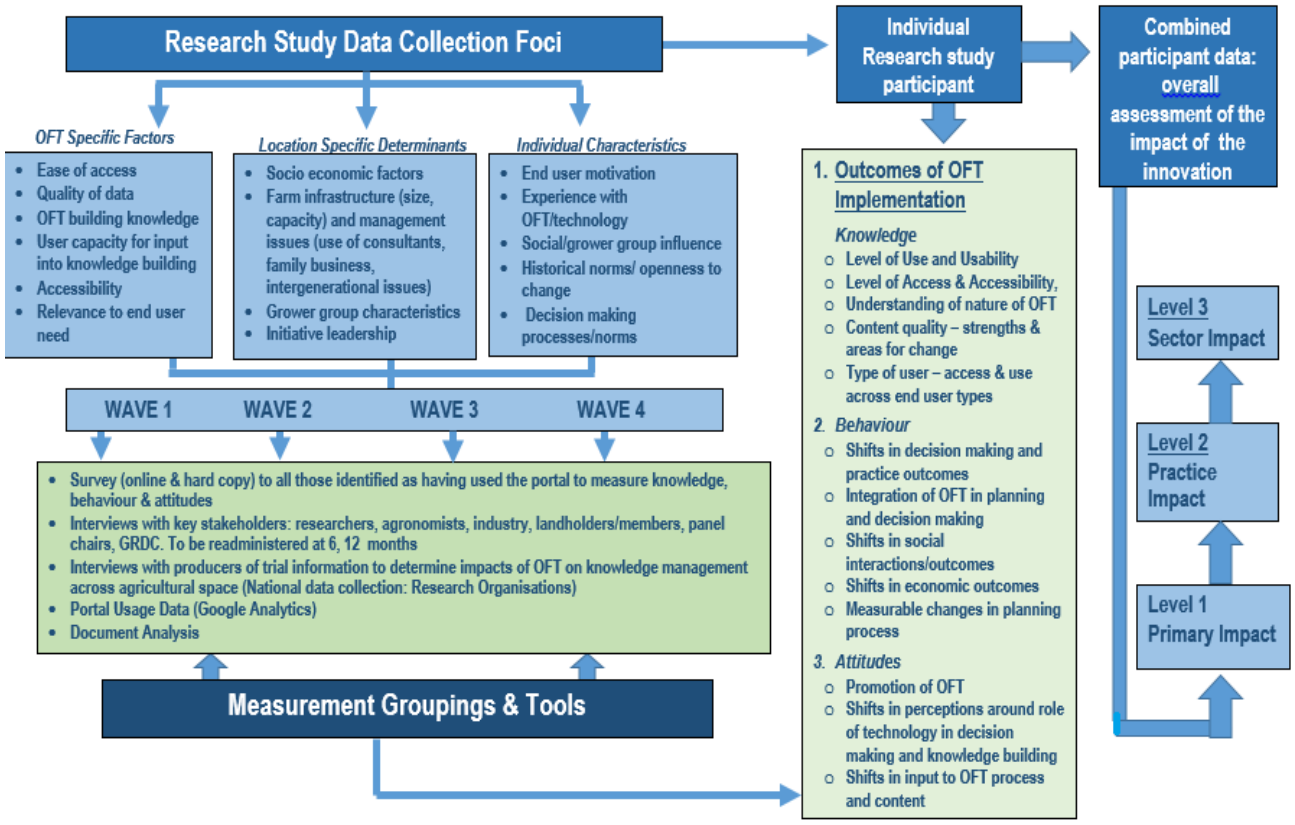
Level 3: The *Sector Impact* level is based on the extent to which the technological innovation has become embedded as integral to activities and decisions that shape the sector – the industry, the government body, the community and/or the research community. At this level the impact of the innovation can be seen to have moved beyond initial interest and usage, and towards shaping individual planning decisions within the sector.

This typology provides the framework for classification of levels of impact as a result of the innovation and allows a measure of the extent to which that impact has become embedded, and changed practice and behaviour.

For wave one research (this current study) evaluability assessment indicates that the innovation is only developed sufficiently for an impact analysis to occur against Level 1 *(Primary Impact)*. All data collected and analysed for this current study was therefore undertaken against the ratings criteria developed for Level 1 Impact.

The study design for the OFT Wave 1 research project has mapped out study rational, data collection tools, timeframes for collection, research questions and links to both individual and systemic outcomes measurements. These components, and the links between them, create the conceptual framework for this study. They are mapped and presented diagrammatically in the following figure.

The Conceptual Framework against Levels of Impact



The OFT research study is part of a larger Multiple Bounded System Design (MBSD) which aims to maximise understanding and build levels of research validity in terms of the impact of innovation. CeRDI, through the mechanism of the MBSD, seeks to measure the capacity of open data, through technological innovation, to achieve sustained practice change and build empowerment and ownership across groups, communities and industries. This will be tested across six projects, of which OFT is one.

The six projects that have been included in the CeRDI MBSD are:

- *Online Farm Trials Research;*
- Historic Urban Landscape Ballarat;
- Natural Resource Management Planning Portal;
- Visualising Victoria's Groundwater;
- Fire and Emergency Management Planning;
- Waterwatch and EstuaryWatch.

These six research innovations will each be examined as a single case study within an overarching multiple case study research project which will allow for comparative analysis of emergent impacts and trends that are specific to open access overall and validated across six distinct studies.

Research Study Findings

The overall break down of data collected and analysed across each of the data collection techniques for this current wave of data collection (Wave 1) is outlined in the following table

Data collection methods	Data collection Period	Profile of data accessed/ participant type	Numbers
Document analysis	2013 – 2015	All documents relevant to OFT (promotional and marketing, web site; funding applications; external documentation and agreements re OFT) were reviewed using qualitative document content analysis techniques	N/A
Individual Interviews	June 2015 to February 2016	• Growers groups • Agricultural Consultants • Industry Representatives • Panel members • Funding body representatives • Researchers • Growers	37 Participants
Online Survey	July 2015 to November 2015	Site users, including, but not limited to: • Growers groups • Agricultural Consultants • Industry Representatives • Panel members • Funding body representatives • Researchers • Growers	Participants from a Victorian grower group.
Email Feedback	2013 - 2016	• Growers groups • Agricultural Consultants • Industry Representatives • Panel members • Funding body representatives • Researchers • Growers	89 participants
Google Analytics	July 2013 – January 2016	This involved the tracking of service usage data for users who have accessed the OFT web portal from project commencement until the end of the data collection period in January 2016.	N/A
TOTAL PARTICIPANTS			131

Participation rates, for the survey and interview process, varied across states with 11 participants coming from Western Australia, 28 from South Australia/Victoria and 3 participants drawn from Queensland/New South Wales/the Australian Capital Territory. These differences in participation rates, when combined with corresponding differences in data input rates for OFT, signals the need for some additional engagement and support processes to be put in place for particular states within the OFT target groups to maximise levels of involvement in OFT.

Based on the data collected from these sources, a number of key insights were gained across a number of different themes that emerged as part of the process of data analysis. These findings, and the themes to which they are linked, are outlined below.

The 'ready measurables' and what they tell us about OFT

The key findings in relation to this theme of the research study identified that:

- A consistent message from across the pool of research participants was that there has been a long standing need in the grain industry for an online resource that would be readily accessible, and that would establish a coordinated and easily navigated system for the body of farm trial data that exists in the grains sector. This assessment was not specific to OFT but rather an overarching assessment of a key identified requirement for achieving best outcomes in this agricultural sector.
- Since establishment of OFT, the access and usage rates have remained low. While usage rates need to increase markedly to achieve optimum levels, the current results were assessed as being mitigated by a number of key factors including:
    - The early stage of development of OFT. The process of establishment and piloting of the project impacted on levels of usage in the first twelve months of operation.

However, the focus on project development, information sharing and resolution of implementation issues was viewed as a positive process, and one which was pivotal in shaping project extension and consolidation.

- The small scale nature of the OFT pilot (it comprised three grower groups), while appropriate and necessary for the initial stages of OFT development, resulted in limited awareness of OFT at the national level. As more groups become part of OFT (with numbers having grown from three to 20 in the last year, 13 of which have already gone live), the rate of usage is likely to increase accordingly. This assessment is validated by the fact that usage levels have been increasing consistently, and in parallel with OFT expansion levels.

These issues mean that reliance on levels of usage as a sole or primary measure to determine adoption success is flawed as usage is mitigated by the context and demands of early stage implementation of OFT.

- Despite constraints on uptake, linked to early stage implementation demands, analysis of usage figures show that, while the overall number of users for the data collection period was found to be low (3765 users for 9253 sessions) the percentage increase from the first three months of data collection (June – August 2014) to the last three months of data collection (December 2015 – February 2016) was 565%.

  This high percentage increase was a continuous trend from point of establishment (June 2014) to point of data collection and analysis (February 2016).

- While the quantitative finding demonstrated that rates of usage were low, which could, in a very initial assessment, be translated to represent a negative view of the value of OFT, qualitatively 100% of those involved in the interviews assessed OFT as a valued and needed resource to support informed decision making by key stakeholders in the grains sector of agriculture.
- OFT was assessed as having a high potential for success because it uses localised agronomic data, encourages and supports end user input, and, by using data sets that remain with their custodian groups, ensures that there is no loss of local relevance and ownership. This building of a collaborative platform, in addition to ensuring that the content of

OFT has maximum relevance, has also been instrumental in facilitating the development of feedback loops between the OFT team and participating groups. The existence of strong feedback loops was assessed as being instrumental in collaborative issues identification, clarification and resolution.

- The strengths of the OFT design were identified as being:
    - Ease of Navigation
    - The search function
    - The user friendly interface
    - Speed of access
    - The Visual display and presentation

  While there were criticisms raised by a small number of research participants relating to these design features (one individual felt it was clunky, another that manoeuvring through the maps was difficult and another did not find OFT particularly visually appealing), the feedback overall on content, presentation and usability of the technology was positive. Other valued components of OFT, as determined by both interview participants and survey respondents were:
    - The filtering tool
    - Access to the original trial reports
    - The map search function
    - The trial summaries
    - Legacy data
    - The capacity for comparison across trials and across locations

  The fact that these elements were raised by BOTH survey respondents and interview participants on a number of occasions, both within and across interviews, highlights the value placed on them by end users.

  The need to maximise mobility of OFT was identified by end users as an important part of increasing use of the resource. In 2015 CeRDI responded to the need for enhanced mobility through development of a responsive design for OFT to achieve optimal viewing and interactivity across a wide range of devices. While this work has enhanced levels of mobility, the amount of data that needs to be accessed can result in mobile access achieving less than optimum results, particularly in instances in which internet connections are not strong. This is an ongoing program enhancement task for the OFT team.

- There were variable assessments made across the data collection pool in relation to quality and the importance of quality assurance in relation to OFT. Three dominant themes emerged in relation to this issue:
    1. High quality and High trust. Those who had been involved in the building of the data sets were more likely to assess that they had a high level of trust in the resource and that they believed that the quality of the data could be rated as high. For these participants, OFT provided good quality data across key areas of relevance to their practice, and they stated that they felt confident in using the information to support the process of decision making. Within this group it was identified that, while local ownership of information was likely to enhance confidence in the quality of the data, there were also transitional issues in releasing control over the information, and making localised information available at the national level. There was some struggle associated with accepting the need for a doubling up of information and moving toward understanding the additional benefits that could be gained through a nationalised system. These issue were resolved reasonably quickly but signalled areas that need to be accommodated as new groups become part of OFT. There was also the identification that ongoing recognition of data ownership and the contribution of local groups and communities was important for trust building and sustainability of collaborations.
    2. Low quality and Low trust. This group, albeit comprising a small number of research participants, argued that there needed to be more transparency in regard to the quality of different trials. This assessment was made within the context of maximising scientific rigour and ensuring that users were aware, from the outset, of the strengths and shortfalls of different trials and different data sets. In this group there was the call for the implementation of strategies such as: 1) pre and post testing of soil, growing conditions and sowing methods to enable informed and accurate trials results comparisons; and, 2) a quality rating system to ensure that any comparative work

between and across site locations and trial type could be undertaken within the context of understanding differences in levels of evidence. This would be a legitimate and measurable way of enhancing the capacity to achieve genuine comparability.

3. Buyer beware. This group argued that OFT provides a unique, and previously unavailable, opportunity to access a range of data sets. Those in this cohort, comprising approximately a third of the research pool, argued that the providing only data of a set scientific quality can be exclusionary. For this group, the allocation of a rating scale ran the risk of excluding data sets that, if accessed, would be beneficial in building an overall understanding of, and insights about, a range of issues of importance to the agricultural sector. Additionally, data custodians were viewed as having responsibility for making professional choices around what should, and should not, be uploaded for public access.

Individuals and groups were assessed as having the capacity to make their own choices around data quality, with decisions to rate (and potentially exclude) data potentially limiting the options available for informed decision making. Buyer beware was a theme for this sub set of participants; people are unlikely to choose a single data source for decision making. OFT, while viewed as an important new industry standard, was still only one part of knowledge building.

Overall there a range of views around the quality of the data sets contained within OFT and the extent to which they can reliably be used for research as well as practice decision making. These views are not mutually exclusive but are part of a range of views that need to be understood and, wherever possible, accommodated, in order to address the complex quality jigsaw.

The overall summary for the elements relevant to Level 1 (Primary Impact) assessment that were addressed and rated in this section of the report are listed in the following table, along with their overall rating (and a very brief summary of rational for the assessment given). Only six out of the eight elements were able to be rated based on the data gathered in this sub section. Other elements will be considered in subsequent sections of this Executive Summary.

Area reviewed for Impact Assessment	Rating given	Rationale
Level & frequency of usage	 Assessed as needing further development but still working toward the middle point of development	Based on the survey and interview data mapping usage rates for OFT were uniformly low across data collection methods. The rating given was '2' as the level of usage has shown a consistent increase across each month since establishment, emerging as an upward trend.
Assessment of data quality	 Assessed as moving toward the higher end of the ratings spectrum	Based on a cross referencing of outcomes and the fact that there was a continuum of rating for quality – from the very high through to the lower levels – and a significant number rating at the middle of the continuum. However as Wave 1 research is measuring for *Primary Level* impact the focus must be on the criteria set for this level. This criteria calls for a rating of 3 which is that 'the quality of information, as assessed by end users, was consistently viewed as being of a high standard in terms of meeting user needs and, in instances where there is a quality issue, end users see this as a collective issue and ensure that this is addressed through provision of feedback and/or the provision of new information, as required'. To accommodate the fact the variability in views (albeit for small numbers), the rating was downgraded to '2.5'. This will be monitored and modified in the next wave of data collection.
Usability and navigability	 Assessed as being at the highest point of attainment for this level of impact	Based on the survey and interview data mapping which identified a high level of positive feedback for the information contained on OFT. The portal has visual and capability aspects that are unique and not found at other sites. Navigation is intuitive and the data sets enable the presentation of spatial maps, grains legacy data, and cross site comparative data. The visual aspects of the portal are presented in a way that enables the user to

Area reviewed for Impact Assessment	Rating given	Rationale
		access information that captures what they view as integral to informed decision making.
Participant experiences of the innovation	2 Assessed as at a middle point of development	The rating for participant experiences of the resource was good across both survey and interview data. There were some examples, of instances in which users had had a positive experience when access or working with OFT. There was a reasonable indication that OFT assessed as a valuable resource or one that had potential to have relevance for end users into the longer term. There was some reasonable indication given that issues or concerns identified with OFT had been critically reviewed, with the aim of putting in place measures to address these.
Level of support and feedback provided by the OFT team	3 Assessed as being at the highest point of attainment for this level of impact	Based on a content analysis of interview data in which the consistent feedback was positive on this variable. No negative feedback on this issue was recorded. There were clear and well documented processes and/or mechanisms in place to facilitate the allocation of roles and responsibilities and to establish processes of inclusiveness across end user groups. The nature of these process could be assessed as being likely to result in good level of end user confidence in the support structures offered through the OFT implementation team.
Trust in the resource	2 Assessed as at a middle point of development	Based on a cross referencing of outcomes and the fact that there was a continuum of rating for trust – from the very high through to the lower levels – and a significant number rating at the middle of the continuum. There were a range of examples found, throughout embedded feedback mechanisms and through research processes relating to end users trust of the content and applicability of OFT. There was a good level of confidence expressed that the content could be used to inform decision making, expand knowledge through legacy data and enable comparative analysis of locational differences.

Unique attributes changing sector capabilities

In regard to the unique attributes of OFT that are likely to impact on decision making capability, the findings drawn from data collection and analysis process identified that there is:

- A high value placed on the potential of legacy data for shifting the decision making process and allowing greater pools of critical data to be included as a matter of best practice. The potential to access legacy data was particularly valued because it was a mechanism through which to overcome previous barriers to informed decision making caused by:
    - The quantity of hard copy reports that needed to be reviewed on an individual basis in order to find trends (or even just individual trials) manually.
    - The lack of an open access farm trials cataloguing system across timeframes and across locations – which meant that, even if stakeholders were prepared to review data held in individual hard copy reports, it was not easily possible to know what was available and where the data was held.
    - The subsequent inability to readily to compare and contrast farm trials across zones – both locational and time.

OFT was viewed as a tangible mechanism to address these – through the power of legacy data. The key benefits of access to legacy data were identified as being:

- Building a repository of trial information – a filing cabinet holding all trial data in a way that was not possible in the past. This was viewed as a critical starting point for enhanced decision making - but by no means the end point. The digital 'filing cabinet' was viewed as the foundation through which to make the data come alive for end users – enabling them to use legacy and comparative capacity to shape decisions in a way that was not previously possible.
- The fact that there was now a simplified system for agronomists, extension officers and growers to access information across previously isolated (by grower group boundaries and data storage approaches) trials spanning time and location zones. The subsequent creation of a new capacity for decision making which, as a starting point, could be informed by accessing pools of data that were user friendly, used non-scientific language and had capability to allow for compare and contrast was viewed as a major advance. This development would ensure that end users were able to maximise their knowledge and readily draw on all available data of relevance to their decision making.
- The ability to minimise trail duplication through an enhanced knowledge base of what has already been done. This was also viewed as a way to maximise efficiency in research funding and to drive an increased focus on meeting knowledge gaps through targeting new farm trials for identified knowledge shortfalls.

  The value of legacy data for mapping the scope of Research and Development in the grains industry was also identified as an emerging benefit of OFT.

- An increased level of assessment emerging on the usefulness of elements of OFT for shaping decision making by research participants. The OFT resource areas identified as useful for decision making were:
  - Methods and treatment
  - Trial results
  - Soil conditions
  - Climate
  - Resource and the report library

  The fact that strengths for informing decision making were identified across so many elements of OFT was an important finding of the research. Data collection tracked and presented the early emergence of examples of the use of key elements of OFT in the decision making process (these are presented as case studies in the body of Section 4.3).

  Particular points of usefulness of the information on OFT for informing the decision making process were identified as being:
  - Providing an increased capacity to respond to a specific issue – based on an increased capacity to search and filter to gain insights around the issue under consideration
  - Allowing a previously possible availability to comparative data.
  - Having a simplified mechanism to track what has been successful and what has not. Knowing what not to do was considered to be valuable because it allows a process of filtering and informed elimination (or inclusion) and subsequently strengthened the depth of the decision making process for the end user.
- At this point of OFT development, there is limited capacity to use it make decisions that are likely to have an economic impact. Participants identified that information that has the potential to deliver economic benefits would be welcomed in the grains sector and amongst key stakeholders. There was however no measure in place, at this point in the data collection process, to determine economic impact of OFT. Examples of ways that OFT might deliver economic benefits were provided by research participants, and potential decisions driven by economic imperatives were explored. It is clear that work will need to be done to develop economic modelling for inclusion in the subsequent waves of data collection for this project.

The overall summary for the elements relevant to Level 1 (Primary Impact) assessment that were addressed and rated in this section of the report are listed in the table below, along with their overall rating (and a very brief summary of rational for the assessment given). The remaining two out of the eight elements were rated based on the data gathered. Additionally 'participant experiences of the innovation' is again included for rating as there were data findings in this section of the report which are of relevance to this elements of Level 1 (*Primary Impact)*.

Area reviewed for Impact Assessment	Rating given	Rationale
Potential for further development	2.5 Assessed as moving toward the higher end of the ratings spectrum	The information provided through interview data highlighted a range of unique capabilities that indicate a forward movement toward positive OFT development. This meets the requirements for Level 1 and it was identified that there was an overt and consistent message provided that participants could identify the potential of OFT (either currently or in the future) to be used as a resource with capacity to enhance and support future development initiatives within the sector and/or for research and data discovery and a framework for building characteristics and capabilities likely to be beneficial to the grain sector into the longer term. A full rating of three was not given based on findings around development work that needs to be undertaken (and detailed in Section 4.4 of the report).
Usefulness of the content	3 Assessed as being at the highest point of attainment for this level of impact	Survey and interview data mapping identified a high level of positive feedback for the information contained on OFT. There were consistent and significant examples of usefulness or potential usefulness of OFT content in supporting and meeting the needs of the individual and the sector for planning and decision making. Additionally, the majority of participants rated OFT as being extremely useful in terms of legacy data and comparability of data sets.
Participant experiences of the innovation	2 Assessed as at a middle point of development	The rating for participant experiences of the resource was good across both survey and interview data. There were some examples, of instances in which users had had a positive experience when access or working with OFT. There was a reasonable indication that OFT assessed as a valuable resource or one that had potential to have relevance for end users into the longer term. There was some reasonable indication given that issues or concerns identified with OFT had been critically reviewed, with the aim of putting in place measures to address these.

Maximising OFT development into the future

A range of issues relating to development and enhancement of OFT into the future were explored, with the following findings been drawn from the data analysis process:

- There needs to be a reconceptualisation of methods for the roll out of OFT. During the initial stages of roll out since establishment the model applied has been linear. This has involved the development of OFT and an associated assumption that ready availability would be the driver for subsequent uptake. As this was a resource which had been sought by the sector there was a level of assumption that, as a natural transition, end users would seek out and apply the resource to their toolkit of decision making resources. The roll out through the mechanism of grower groups was considered to be the most effective approach as, given that local data was being used at each site, this would facilitate

ready marketing and engagement. Feedback from the research process highlighted that, while not incorrect, this approach needed strengthening and expansion.

There was a need to implement a range of engagement strategies which would maximise uptake into the longer term. These strategies needed to be overlaid with a hierarchy of uptake – i.e. targeting first agricultural consultants and grower groups and then, through successful engagement of these stakeholders, other potential users. This approach was viewed as most likely to result in an extended uptake involving growers themselves. This was not an exclusive model (in that there remains a number of growers who do not access these resources and therefore cannot benefit from a strategy that targets these groups over others) however it needs to be the dominant model. Targeting these groups as the first step in a staged roll out was viewed as likely to be the most effective strategy for enhanced access and level of uptake.

- The need for ongoing and extended marketing of OFT was identified by the majority of those involved in data collection. Many of the strategies outlined by research participants mirrored much of the marketing work already undertaken by the OFT team including:
    - Presentation and demonstration of OFT at field days
    - Providing newsletters articles about OFT in grower group newsletters
    - Having an OFT newsletter
    - Using experts (or champions) to promote and advocate for OFT
    - Marketing through established grower information sharing resources such as Groundcover
    - Creating links within grower group web sites and with GRDC web applications
    - The use of social media
    - Using education and training as a way to market OFT
    - The presentation and conferences and Annual General Meetings

  The fact that these strategies were emphasised as critical for ongoing marketing of OFT by those involved at interview highlights that, while OFT team strategies for marketing are appropriate for the sector, they are not reaching all relevant stakeholders. There needs to be both an expansion of marketing activity and a structured marketing implementation plan to ensure that relevant areas for marketing focus are identified and targeted into the future.

- It is critical to work toward the establishment of a range of innovation champions. This is a role that should be integrated into the marketing plan developed for enhanced uptake and longer term sustainability of OFT.
  In order to maximise the success of introducing innovation champions, their introduction needs to be bounded by the following defining characteristics of the champion themselves in that they need to be:
    - Locally based
    - Well connected across a number of groups and organisations
    - Trusted and known within the grains sector in that location. This assumes that this individual is part of a range of local networks.
    - Familiar with OFT and able to champion key attributed of the innovation
    - Willing to delivery local education and be involved in OFT marketing processes

  Remuneration for this role could take a number of forms. The role could be a paid one as part of the OFT team, it could be structured as a professional development activity or it could simply involve targeting key individuals with a commitment to the introduction of decision support. Regardless of the approach taken, it is an approach that needs to be applied nationally – mirroring some of the strategies already in place with the OFT team through the use of paid staff in remote locations and the use of domain experts in resource development.

- The development of education and training initiatives for OFT. This can involve a range of approaches including:
    - Delivery of workshops at a range of events. This approach must include the opportunity for practical application and the solving of priority issues for the local context
    - Developing interactive case studies based on identified hot topics
    - Establishing chat rooms for peers and domain experts
    - Developing online resources

There are strengths and shortfalls around each of these approaches and it may be a mixed model will need to be implemented - that the solution is location specific, dependent on identified need.
An education and training strategy will need to be developed in conjunction with the marketing plan to address this need for education and training in a coordinated manner across all States and Territories.

- The inclusion of OFT as part of contractual obligations between GRDC and grower groups through the Regional Cropping Solutions Network (RCSN). There was a consistent message from a group of research participants that issues of funding, integration, marketing and sustainability need to be addressed in a coordinated way in order to maximise the reach of OFT and ensure that it becomes a central resource for the grains sector. Participants who commented on this issue assessed that proactive strategies to ensure that OFT achieves its full potential as a valuable sector resource requires the issue of programmatic sustainability be explored with GRDC into the longer term

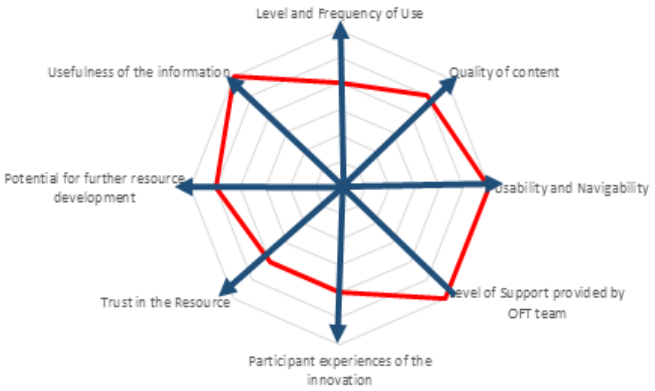
The key element relevant to Level 1 (Primary Impact) assessment for this section is 'potential for further development'. It has already been rated in the previously in this Executive Summary however is again listed in the following table to highlight the importance of using targeted developments (such as marketing, education, programmatic funding and champions) into the future to strengthen the reach of OFT.

Area reviewed for Impact Assessment	Rating given	Rationale
Potential for further development	2.5 Assessed as moving toward the higher end of the ratings spectrum	The information provided through interview data highlighted a range of unique capabilities that indicate a forward movement toward positive OFT development. This meets the requirements for Level 1 and it was identified that there was an overt and consistent message provided that participants could identify the potential of OFT (either currently or in the future) to be used as a resource with capacity to enhance and support future development initiatives within the sector and/or for research and data discovery and a framework for building characteristics and capabilities likely to be beneficial to the grain sector into the longer term. A full rating of 3 was not given as the level of development remains high for this area. The extent of implementation of these targeted change areas will influence ratings and attainment potential for Level 2 and Level 3 impact assessments to occur in subsequent waves of research.

Study Conclusions & Recommendations

The data collection process has enabled a range of findings to be mapped against the research questions set for the study; a mapping that provides good foundational data for building research insights of relevance to OFT. In terms of the attainment of Level 1 impact (*Primary Level)*, the collection and rating of data throughout the study has enabled the degree of attainment of level 1 impact to be mapped visually. This occurs through the consolidation of the ratings gained across the eight elements being measured over the data collection and analysis process. The collation of these rated outcomes across all 8 elements is provided in following table and figure.

Factor Examined Through Analysis of Collected Data	Rating within the scope of level 1 (primary impact) of the 3 levels of impact
Level and frequency of use	2
Quality of content	2.5
Usability and Navigability	3
Level of support provided by OFT team	3
Participant experiences of the innovation	2
Trust in the resource	2
Potential for further resource development	2.5
Usefulness of the information	3



When mapped visually, the results provide a very clear picture of solid attainment of a Level 1 (*Primary Impact)* during the early stages of implementation of OFT.

Finally, as a result of the research study, a number of key themes have been identified relating to the impact of eResearch on practice decision making, knowledge building and information sharing. These are:

Theme 1: Positive shifts in OFT usage trends are facilitated by high levels of ease of accessibility and confidence in data quality. Upward trends in frequency of use and repeat visitation rates are dependent on these factors and the way in which they enable the resource to be viewed as a viable and sustainable mechanism for information access.

Theme 2: The dominant characteristic of OFT, particularly in relation to access and data reliability, is that it is emerging as instrumental in facilitating the breakdown in knowledge silos. This characteristic, if developed to maximum potential, can shift the dominant paradigm from one of knowledge controlled by individual grower groups to one of knowledge sharing and increased accessibility at the local, state and national level for all end users. The nature of OFT allows for a shift that is a seamless.

Theme 3: Positive experiences for end users in accessing OFT can, over time, shift how they interact with the resource – changing the relationship from one in which the end user accesses the portal infrequently to a more complex interaction which includes end user information input, advice seeking and participation in the process of building/enhancing knowledge.

Theme 4: The provision of diverse clusters of complex information through the mechanism of multiple data sets increases, in an upward trajectory, the relevance and applicability of data and consequently provides end users with a resource to strengthen planning and facilitate informed decision making.

Theme 5: Single access, multiple data set web portals enhance capacity across community and industry in terms of the provision of:

- Timely, informed and accurate responses to those seeking information/answers to queries;
- Improved mechanisms for making informed decisions - maximising the potential for good outcomes and positive developments across a field of study; and,
- Increased potential for collaboration and connection through shared local and national data sets.

Theme 6: The provision of multiple data sets with a single point of access, and the facility of interoperability, establishes a unique opportunity to collate, cross reference and consolidate data that has historically been hidden. This shift establishes a new foundation in accessing research ready data sets and a new capacity for achieving research discoveries.

Theme 7: Technological innovation allows for information access and sector engagement capacities that are not available through more traditional forms of information sharing. This is a notable advance however the introduction of new technology needs to be carefully managed. Before adding more features or datasets it is important, for maximum success capacity, to ensure there is programmatic support to maintain and enhance the usability and capacity of the resource.

Theme 8: Sustainability of technological innovations beyond seed funding requires targeted marketing and a capacity to provide a solid body of evidence on the successes of the innovation and the benefit it provides to the community and the industry for whom the technology has the greatest relevance.

These are significant themes and consolidate existing knowledge around the value of this type of resource for the grains sector.

In order to strengthen OFT development into the future, the following recommendations have been developed and are put forward for consideration:

Recommendation 1

That the OFT team target the provision of additional implementation support to grower groups in Queensland and New South Wales. This target is needed to maximise involvement from these areas in the OFT initiative. Queensland and New South Wales are currently under represented nationally in the number of farm trials uploaded, and in the level of participant feedback to the research process. The provision of focused support is likely to enhance future participation in OFT research and, importantly, in achieving a more nationally balanced upload of full trial reports and full trial results.

Recommendation 2

That negotiations occur with research scientists at a variety of key organisations, including CSIRO, GRDC and CeRDI, to establish research planning collaborations. These collaborations will provide the means through which to establish, wherever possible, uniform farm trials development standards. This work should include the identification of a range of quality enhancement strategies for farm trial data into the future. These could include the introduction and inclusion of pre and post-trial variables such as soil, growing conditions and sowing methods to maximise knowledge in terms of data variability across trials and enhance comparability for research application of farm trials data.

Recommendation 3

That the OFT team, in consultation with targeted domain experts, work on the development of an inventory of practical techniques aimed at combining legacy data, comparison capacity and evidence held within OFT to shift the potential of OFT from a repository to a live decision making support tool. While the nature of this inventory is yet to be determined it may include:

- building links to other repositories of evidence;
- targeting specific priority issues in the sector as pilots for ongoing exploration;
- the development of OFT research application toolkits; and/or;
- the use of 'flagship' trials to map the data to research discovery process.

The overall aim of this approach is to develop use friendly options for the practical use of OFT in decision making.

Recommendation 4

That work be undertaken with domain experts in the measurement of economic cost/benefit programmatic analysis to identify ways to facilitate the incorporation of economic modelling into subsequent waves of data collection for OFT research. Once these have been developed, that work be undertaken in conjunction with the OFT team to ensure that potential economic impact of OFT is captured over subsequent waves of research for this study

Recommendation 5

That the current linear model of establishment, implementation and uptake that has, in the main, characterized the early implementation phase of OFT be redesigned to reflect a more staged approach. The revised model should include a range of uptake enhancement strategies relating to marketing, education, championing and the role of contractual obligation. While recommendations specific to each of these will be detailed in the following recommendations (Recommendations 6 10), an overt transition to a staged and less linear notion of uptake needs to be discussed and implemented as part of OFT team forward planning to maximize the capacity for longer term sustainability of OFT.

Recommendation 6

That a detailed marketing plan be developed for OFT. This plan should adopt a holistic approach to incorporate documentation of the strategies identified in Recommendations 7 & 8 and providing integrated links between and across strategies in order to capture implementation priorities, timelines and modes of delivery. The development of this plan aims to ensure that there is a structured, timed and mapped marketing strategy in place to align with current and future roll out targets for OFT.

Recommendation 7

That the OFT team, in conjunction with consultation involving GRDC, domain experts and grower groups, detail a process for the identification of innovation champions. This process should include the overt identification of the key characteristics needed for innovation champions and suggestions of potential early innovators to be involved in this program start up. The characteristics that need to be included in innovation champion selection should include: those with domain expertise; having good local and national networks; holding strong professional links across the community; an individual assessed as being a trusted expert in the target community; as well as, having an understanding of OFT and how to maximise its potential for use in decision making.

Recommendation 8

That the role of the innovation champion be expanded to encompass active participation in education and project development. This approach will ensure that the process of information sharing and knowledge transfer is holistic, succinct and representative of the potential and place of OFT in the grains sector. Implementation of this recommendation will require champions to work closely with the OFT team, with grower groups and with identified key stakeholders in the sector. As part of implementation of this recommendation pursuing options for funding of this level of integrated involvement in project roll out need to be explored.

Recommendation 9

That, linked to the overall marketing plan for OFT, an education and training implementation plan and schedule be developed. This should occur as a matter of priority and should be an integrated component of the next stage of implementation/roll out of OFT. The overall focus of this plan should be on maximising training and development approaches and minimising demonstration as the dominant approach to seeking end user engagement.

Recommendation 10

That the potential for the inclusion of a mandated requirement to upload farm trials data onto OFT be discussed with GRDC. This approach would mean that OFT would become part of the compliance obligations of grower groups nationally, and is a shift that was identified as needing to be explored during the research process. This approach provides a mechanism to maximise viability and usability of trials data for research, to enhance sustainability into the longer term, and to support uniform industry standards relating to farm trials research

Section 1. Introduction

1.1 Background

The Online Farm Trials (OFT) Project is an eResearch project developed and delivered by the Centre for eResearch and Digital Innovation (CeRDI) at Federation University Australia. It has been operating since 2013 through funding from the Grains Research and Development Corporation (GRDC), using new technologies to maximise access to current and past grains industry research data. Online Farm Trials (OFT) is led by a team of CeRDI senior scientists, researchers and programmers, with additional expertise drawn from external agriculturalists who are experts in their field.

The approach used for OFT is highly collaborative – overtly recognising the importance of local input, partnership and project ownership in achieving sustainability in the long term. To this end, collaboration occurs with grower groups, research organisations, agricultural experts and grain industry organisations aimed at the provision of a resource for industry. This industry includes grain growers, agronomists, GRDC, government representatives and researchers. The establishment of a platform of collaboration in development and implementation has resulted in a resource that will help groups to better respond to industry challenges associated with climate and natural resource management.

The principal objective of the OFT project is to help improve the productivity and sustainability of farming enterprises by improving access to trial research information. The OFT project achieves this through two online research applications: the Trial Explorer and the Report Library.

The Trial Explorer allows users to search and filter farm trial projects from across the country to provide targeted results before giving users the opportunity to view, share and export the relevant information. Additionally, a subsidiary tool of the Trial Explorer – the Trial Browser – provides users with the opportunity to browse trial projects in areas where slow speeds restrict internet access.

The Report Library gives users the ability to search an online repository of grains industry research documents such as trial reports, case studies and project summaries for further information regarding their area of interest.

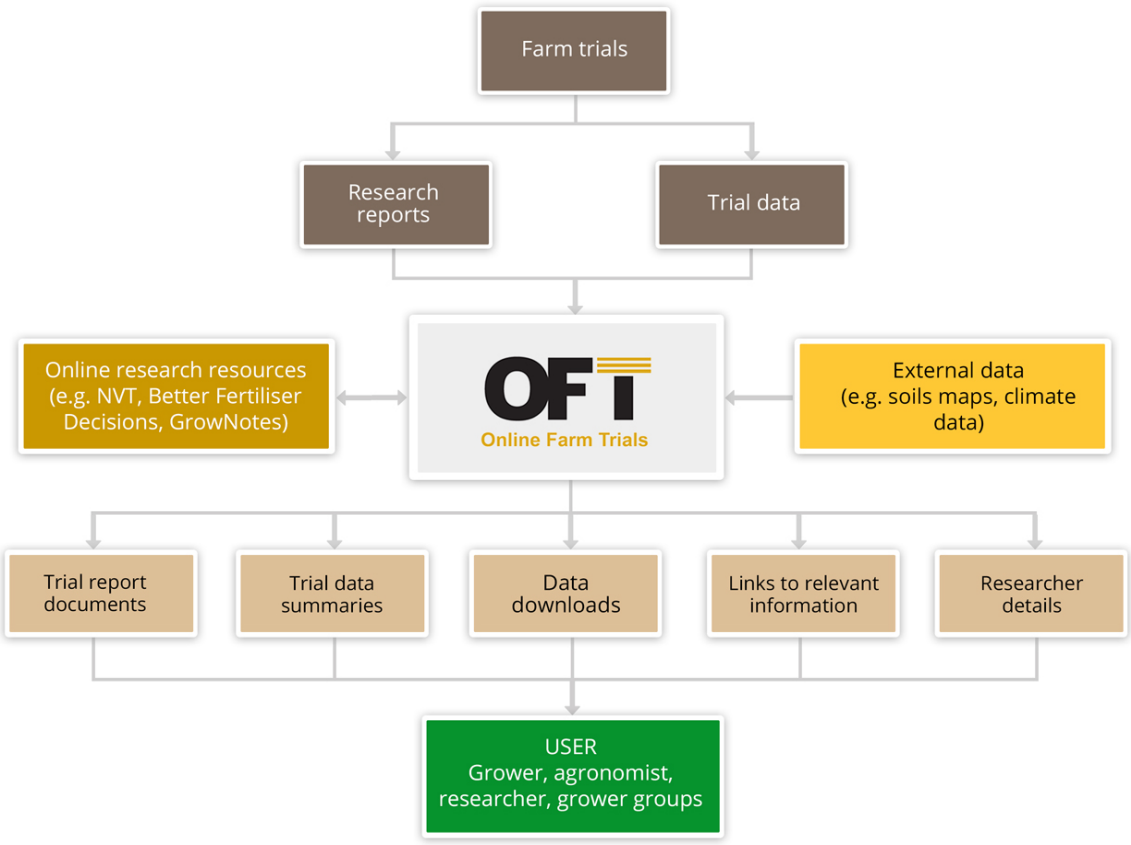
Key features of the OFT project include:

- online analytical tools for growers, agronomists and researchers, at various points of development;
- an online digital library of national farm trial research reports and supporting documents;
- direct online access to trial research data in digital form with download capacity;
- linking of other sources of relevant trial research information; and
- increased networking and collaboration on cropping issues and farm trial research.

The OFT project marks a new era for the grains industry with the unlocking of data from the farm trial reports that have been largely hidden away; accessible only via hard copy or basic electronic documents. The use of new technologies to publish, support filtering and querying of the farm trial data presents new opportunities for growers, researchers, agronomists and farming groups, to access research that is relevant to grain variety, climate, soil, agronomy and growing techniques that could lead to improved industry practices.

The structure and delivery characteristics of OFT is captured in Figure 1, which illustrates diagrammatically the elements of OFT, as well as the links embedded within it, and those involved in the project, either as contributors and/or end users.

Figure 1: The OFT concept



1.2 Project development and research imperatives

The OFT project commenced with a pilot involving three grower groups located in New South Wales, Victoria and Western Australia. That first phase of OFT included over 1200 trial projects (over 800 of which included data), 11,000 individual tests, 1000 variety types, 4000 treatment types and 36 unique measurement types.

Since commencement, the project has expanded significantly to include a range of participants from across Australia. At the time of writing this report, there were 20 grower groups and organisations which had provided trial data and were either in the process of entering their data into the system or were already online. As at 30th January 2016, 13 of these grower groups and organisations had been published on the Online Farm Trials website, with this number to increase as more data is entered and signed off as ready for open access. Currently available data can be accessed at http://www.farmtrials.com.au/

In parallel with the process of rolling out the project nationally, a project imperative has become to undertake impact research to determine a range of factors specific to project implementation and development. These include assessment of implementation issues, barriers and enablers to uptake and the impact of the OFT initiative on factors such as: 1) decision making; 2) farm development and environmental management processes; 3) enterprise enhancement; 4) issues of intergenerational change and decision support techniques; and 5) overall practice change.

The decision to enter into a research program in parallel with the implementation of OFT was based on an understanding of the importance of enhancing implementation and maximising sustainability while building a body of research evidence. Meeting these imperatives required the tracking of short-term and emerging knowledge about the OFT resource. It also required the building an evidence base and knowledge repository relating to the value and impact of technology and open data access to the individual, the organisation, the community and the grain-growing sector.

The first step for building this evidence base has been a literature review on the use of technology in agriculture and in decision making support. The literature search spanned the years 2000 to 2016, with the majority of the work drawn from the available pool of research published between 2005 and 2016. The OFT initiative is defined, in terms of end users and content, by the fields of agronomy and agriculture; however, the literature searched for this study drew on the insights provided by a broader range of disciplines including environment and ecosystems behaviour, information technology, economics, business and the political and social sciences.

A particular focus was given to the availability and efficacy of online decision making support in empowering individuals and sectors in building practice excellence and enhanced research knowledge.

The search scope of the literature review included the following key themes:

- determinants of decision making;
- environmental impacts;
- the role of networks;
- barriers to change and innovation,
- learning and education,
- technology in farming,
- adoption enablers, and
- the role of eResearch for achieving practice change.

The insights gained through this process provided foundational knowledge from which to develop the theoretical underpinnings of relevance to the study design for this research. This is detailed in Section 3.1 of this report.

Section 2. Literature search overview

A notable body of research relating to the growing role of information technology and decision making support systems across a range of industries, including in primary production (Brennan, 2007; Long & Hunt, 2007; Long, 2009; 2001; Long & Cooper, 2011; Nguyen et al., 2007; Wenkel et al., 2013) was reviewed. Across this evidence base there has been consistent identification that access to knowledge is an important catalyst for behavioural changes (Jordan et al., 2011). This finding aligns closely with the central theoretical tenet of OFT: that OFT aims to enhance knowledge building and, through this, facilitate behaviour change and informed decision making. This goal was clearly developed during establishment of the OFT project and embodied within the objectives of OFT; to help growers improve productivity and sustainability of their farm enterprise through improved access to trial research knowledge.

To maximise attainment of this objective, it is important to draw on existing research knowledge on processes most likely to ensure successful uptake of technology as a mechanism for knowledge building. Analysis of available literature has provided valuable insights that can help build the overall map on what needs to be in place for successful technological innovation. The consistent themes that warrant exploration in this area relate to:

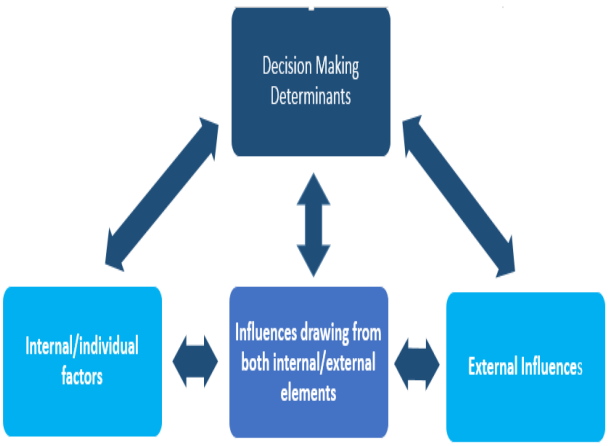
- farm decision making (and subsets within this);
- information and knowledge transfer; and
- technology in farming.

Each of these emergent themes will now be explored in detail.

2.1 Farm decision making

Research examining the influencers on decision making within the agricultural sector has provided knowledge from which to build implementation approaches for new innovation. Importantly, analysis reinforces that plans to work with decision makers cannot occur in isolation, neeither can it occur with the assumption that the establishment of a technological innovation will, in and of itself, result in high levels of uptake and application. At the individual farmer/agriculturalist/consultant level, a range of studies have provided insights into what can shape and define decision making and farm practices (Buys et al., 2012; Dahlhaus et al., 2014; Heimlich & Ardoin, 2008; Long & Cooper, 2011; Long 2011; 2012; 2013; Mesiti & Vanclay, 1997; Milne et al., 2008; Nicholson et al., 2015; Swartz et al., 2009; 2013; Thomson, 2002; Toomey & Domroese, 2013; Wright & Morton, 2009).

Figure 2: Decision-making determinants



Although many of these studies were not specific to the uptake of technology, they give emphasis to the place of personality, farming styles, the risk environment and business type in influencing decision making. These studies have highlighted definitively just how complex decision-making processes are, with a broad range of factors being integral in determining those decisions that ultimately shape practice (Barnes et al., 2013).

The central themes that can be drawn from available research show a strong interconnection between internal (and individual) factors and a range of external influences. This becomes more complex when what individuals internalise, and what is external to their

individual locus of control (as depicted diagrammatically in Figure 2), needs to be accommodated as part of the decision-making process.

Figure 2 illustrates the extent to which a broad base of influencers need to be considered when working to enhance uptake of innovations such as OFT.

2.1.1 Individual styles, personality and value bases

The current evidence base on internal factors highlights that are integral to mapping the range of influences on farm decision making are individual personality traits and value bases. Significant work specific to the field of agriculture has been undertaken on this issue (Long & Cooper 2011; Long, 2011, 2012, 2013; Nicholson et al, 2015; Swartz et al, 2009; 2013). Personality types play an important role in determining how an individual approaches their farm enterprise, and decision-making processes within this. This includes the type of agricultural consultant they engage and the extent to which they embrace and accommodate innovation and change. Strachan's (2011) study found that over 80% of farmers have personality types that either resist change or reject changes that are too abstract or theoretical. Individual views and internalised rules, beliefs and feelings, linked to personality, help determine what motivates an individual to adopt different approaches, and set individual priorities for action. Often, even though individuals will access available information and advice, the determination of relevance to their individual enterprise will be accommodated within the framework of individual personality types and individual learning styles.

Decisions that may appear illogical and/or based on 'gut' feelings over evidence are often driven by internal factors such as personality, values and experience. Decision influencers can include legacy data, intuition, individual learning styles and practice approaches – particularly those that have been foundational to successful practice in the past (Long, 2011; 2012). When these influencers are embedded it can be difficult to shift decision making to embrace technological innovation for decision support and this can act as a barrier to change (Long, 2013). This is particularly relevant if the agricultural adviser with whom an individual [farmer/grower] works has similar worldviews, personality type and/or an approach driven by internal drivers such as intuition and past experience (Long, 2011; Ricards, 2009).

Personal farming goals and objectives within the context of available infrastructure, farm size and farm management organisation are closely linked to personality and internalisation of decision-making processes, values, beliefs and rules. If an individual is not able to establish a sense of congruence between the goals that they have set for their farming enterprise and a potential change in planning approaches, then they are likely to resist making particular decisions or accepting innovations that support these decision-making processes. Awareness of these internal influencers highlights the importance of accommodation of and response to internal factors when planning strategies to enhance and extend uptake of innovations.

One mechanism that has been identified as critical in this process relates to networks and the role that they play in the decision-making process.

2.1.2 Networks

Networks have been identified consistently as having an impact on decision making across a range of sectors and domains (Blackstock et al., 2010; Bodin & Crona, 2013; Wright 2011), with their influence in the farming sector consistently highlighted as integral to modern industry management (Anil et al., 2015a; 2015b; Baumgart-Getz et al., 2012; Gianatti and Carmody, 2007; Hall and Wallis, 2013).

Networks provide critical social and peer interaction and are fundamental in influencing practice approaches and decision making (Eastdown & Starasts, 2004; Taylor, 2013). There are a range of networks of relevance within agricultural communities including peers (what neighbours are doing on their farm enterprises), social groups, local and industry based communities and key professionals (such as grower groups, extension officers and agricultural consultants). These networks provide a way to gain opinions, advice and practical techniques (expert and peer

based) on products, practice approaches and shifts within the sector (Aguilar- Gallegos et al., 2015; (Al Musawi, 2014; Anil et al., 2015a; Easdown & Starasts, 2004; Gianatti, 2005; Knowler & Bradshaw, 2007).

The networks with which an individual surrounds him or herself creates what is termed 'the web of influence', which refers to a complex and interrelated web that includes other farmers, expert agronomists and consultants. Each of these participants to the web enters into a reciprocal relationship through which each influences the other, creating particular approaches and worldviews in relation to farm decision making and forward planning (Anil et al., 2015a; Attanandana et al., 2007; Llewellyn, 2007).

The web of influence is a multifaceted concept. Although awareness of this web builds understanding of the importance of networks when attempting to influence decision-making processes, it remains difficult to readily identify who the key influencers are within each complex web – particularly as the level of influence can shift between members depending on the issue, the situation or the timeframe. The web of influence plays a critical role but the extent to which it is the key driver for adoption (or rejection) of new approaches and practices, including new technologies, is difficult to quantify (Bellotti & Rochecouste, 2014).

However, knowing how important networks are when working to increase levels of adoption of technological innovation and having an awareness of the scope and complexity of networks helps clarify the breadth of the communication and information sharing process that needs to occur to maximise capacity for innovation adoption success. This is particularly important within the context of relationship building with growers as part of the OFT project. Available literature has reinforced the critical role of individuals such as consultants within the web of influence, particularly when introducing tools aimed at supporting and shaping decision making (Long, 2011). The trust relationship that is built within the web of influence is an important element in determining the types of innovation and change that individuals are likely to accept and adopt within their farm enterprise. Specific to building participation in digital innovation, research has shown that the network community, and the trust relationship that has been built amongst members of that community, plays a critical role (Park et al., 2015).

Within the context of increasing uptake of innovations such as OFT, grower groups, agricultural consultants and similar sector groups form part of the network influencing the primary producer, and so play an important role in driving adoption. (Al Musawi, 2014; Blackstock et al., 2010). Consequently, they need to be targeted as active participants in the planning, development and implementation of a technological innovation.

2.1.3 External environments

Another factor that has been identified as having an influence on the uptake of innovation is the external environment (Baumgart-Getz et al., 2012; Pannel et al., 2006), particularly as it relates to risk. The economic and political environment that is in place at the point at which the innovation is being rolled out, or is being marketed, will influence levels of adoption. If the environment in which a decision is being made creates a sense of a potential impact or threat to livelihood, then decisions will be made within this context (Nicholson et al., 2015) and the likelihood of using a new innovation as a mechanism to inform and determine decisions is lowered. Conversely, the adoption of alternative practice approaches – including innovations such as OFT – is more likely to occur if the innovation can be shown to provide concrete indicators of the potential for improved productivity. In working to introduce innovation, the influence of the external environment becomes a further factor for consideration and review.

What also need to be considered in terms of the impact of environment are differences in situation and in location. There is lack of information in the published literature relating to diversity within farming communities themselves and their participation/responses to the decision-making process (Blackstock et al., 2010). Not all communities are alike (farming communities, farming types) and consequently, there will there be differences between external environments themselves as well as differences in response strategies and assessments of the relevance of an

innovation for that location, farm type or community. Within this context, the impact of these differences on decision making also needs to be considered.

Given the identification of the impact of external factors, locational and farm type differences, the need to mitigate risk and the consideration given to opportunities for the improvement of productivity within the literature, it follows that these are the factors that need to be overtly recognised and addressed as legitimate components of decision making in relation to practice change, including practice change influenced through the mechanism of technological innovation.

2.1.4 Summary of the literature on farm decision making

The literature in this subsection provides valuable insights into building a stronger understanding of the impact of farm decision-making processes on the uptake of technological innovation. They provide an established evidence base against which to contrast empirical findings gathered for this research study, and detailed in Section 3 of this report.

A summary of the key findings relevant to this literature pool provides the foundational knowledge from which to target the research study design.

Importantly, there was a consistent message throughout the literature that the establishment of a technological innovation, even one that is responding to an identified need, and accommodating a called for change, is not a sufficient determinant of uptake of that innovation. There is a broad range of internal and external factors that shape and define decision making, particularly as it relates to technological innovation. These include:

- personality types;
- individual learning styles;
- value bases;
- personal goals generally and personal goals as they relate to the farming enterprise;
- peer, professional, industry and community networks;
- level of trust within the context of the network;
- levels of risk potential as a result of the change process;
- levels of risk resultant from the social, economic and political environment;
- the contemporary social, economic and political environment; and
- location-related factors; what is happening within the context of community, geography and social 'norms'.

Closely linked to the process of farm decision making is that of how key stakeholders, particularly farmers and consultants, access information and effectively achieve knowledge transfer as it relates to technological innovation.

2.2 Information and knowledge transfer

The availability of adequate information to support informed decision making and, through this, achieve best practice outcomes, has been identified as critical to contemporary industries and sectors. Inadequacy of access to information and knowledge transfer shapes the behaviour and the practice decisions of those working across a range of sectors including the agricultural sector (Hogan et al., 2011). A lack of access to information and knowledge transfer can often result in poor outcomes in terms of innovation, enhanced productivity and individual control over the knowledge-building process. Equally, when high quality information that can be used to build knowledge is readily available, this availability plays a pivotal role in driving behaviour change and, through this, positive practice change (Jordan et al., 2011).

Technological innovation pays a key role in the process of improved information access, providing a catalyst to support the change process. Technology acts as an important leveller by which all stakeholders have greater capacity to access information and, subsequent to this, enhance knowledge, make evidence-based decisions and achieve greater autonomy in determining the scope and direction of their enterprise. Information access through

the mechanism of technology also provides a user friendly way to address shortfalls in traditional, non-technology based approaches that have sought to facilitate knowledge building through information transfer (Dalhaus et al., 2014; Hogan et al., 2011; Shanahan, 2009).

Decision makers who do not have adequate information are at a disadvantage in a number of ways. As identified, a clear disadvantage of limited access to information is in a reduced ability to build a personal and professional knowledge base on the latest research, practice approaches and industry best practice. Within the context of technological innovation, there is also a disadvantage in a diminished capacity to control the process of knowledge building and information access. Further, when individuals are not the end users of technology, the information needs to be sourced through a third party, which is an action that removes a level of autonomy from the knowledge building and knowledge transfer process. The loss of this autonomy in using, learning about, and building skills in accessing information and using this for improving best practice is detrimental to the process of building the potential benefits of innovation and change to the end user. When people do not broaden their opportunities for knowledge enhancement and information control through direct use of innovation, there is likely to be ongoing resistance to accepting, seeking out and proactively adopting the change agenda (Buys et al., 2012).

In order to maximise the extent to which information is accepted and incorporated into normal practice, a systematic review of available research has found a number of approaches to be effective in behaviour modification; particularly in traditional areas such as farming, where there is a danger that embedded practice approaches, a reliance on instinct and a history of working on 'gut reaction' can work against a change agenda (Long, 2011). The approaches identified across the literature with potential to successfully achieve shifts in behaviour are detailed below.

- Ensure that the innovation being presented is of high quality. The opportunity to achieve initial access can occur through a range of marketing and information sharing avenues. However, the window to achieve ongoing engagement is small: if data provided through open access is not accurate, of a high quality, user friendly and relevant, and if this is not the case from the outset, this fundamental flaw is likely to jeopardize the potential for innovation success (Anstiss & Marjanovic, 2012; Haug et .al, 2011; Li et al., 2012; Reeson, 2013). Initial users are likely to disengage, and the re-engagement process can often be difficult, if not impossible. This is particularly true if there is already a level of reticence about the role and potential of technological innovation. This has been found to be the case with farmers and agricultural consultants with particular practice approaches and limited commitment to the value of technology (Aubert et al., 2012; Long, 2011). To achieve a high standard of quality it is important that the information contained within the innovation is updated on a regular basis, is easily accessible and has high levels of flexibility and reliability (Nain et al., 2012; Van Meensel et al., 2012).

- Develop innovations that enable the end user to maintain control over knowledge building and knowledge management. In industries in which there are high levels of ownership and control, such as in small business and in farm enterprises, this is an important part of stakeholder identity and practice approach. If new innovations seek to maximise levels of uptake within these populations, there is a need to ensure that their uptake does not require loss of end-user control (Busch, 2011; Cegarra-Navarro, 2014; Lloyd-Smith, 2009; Robertson et al., 2009; Simpson et al., 2003). There are a variety of strategies to avoid this problem when working in the agricultural sector, including localisation of content, education and support and inclusive product development and implementation. These strategies, and factors that need to be given consideration in their implementation, are discussed in further detail below.

- Ensure that innovations are closely aligned to sector priorities and industry imperatives, and that the potential advantage of the innovation is overt and observable (Anil et al., 2015a). If this is not highlighted to potential end users then the likelihood of the innovation being adopted is diminished (Anil et al., 2015a).

- Work to make sure that the information provided is of local relevance and can help build insights and enhance productivity and practice decisions within the local context. The work of Easdown and Starasts (2004) and Llewellyn (2007) reinforces that the value placed on highly localised agronomic information remains particularly strong, with a drive within this sector for reliable research that has been generated within local farms and local regions. The farm trials movement is a clear example of this type of research, and is an approach that clearly meets the requirement for participation (and ownership). Particular benefits of localisation relate to the capacity to build participation, target priority issues of relevance to specific locations, and build significant levels of engagement within the agricultural community (Nain et al., 2012). In terms of a technological innovation that incorporates many of the prerequisites for participation and engagement, OFT has significant potential for success.

  In addition, greater levels of engagement and adoption are likely to be achieved if the early roll-out (implementation) of the technological innovation (Marsh et al., 2000) focusses on:

  - information management – building skills on techniques and approaches on how to optimise the use of information;
  - farm return benefit – emphasising how, for the type and size of the farm enterprise, using information and adopting what is learnt is likely to provide a good return on investment; and
  - the benefits of spatial technology – illustrating the ways in which spatial technology is able to map out a range of critical elements of the local environment without complex translation of results, scientific findings or application benefit.

  The implementation of innovation in the agricultural sector needs to be rolled out to include these foci if the potential for success is to be maximised.

- Ensure that the information presented for access by end users is not exclusionary in any way. If information access and knowledge transfer are to reach optimum levels, it is important that accessibility is maximised through use of plain language. What is presented must avoid the use of complex scientific language and/or the presentation of complex concepts that cannot be readily grasped and applied by the end users. This requires the system to be user friendly, and the language and logic used to mirror existing approaches used by the sector so they are compatible with existing farm systems (Al Musawi, 2014). Innovations that are dependent on end users having to develop a complete new skill set are unlikely to be adopted (Van Meensel et al., 2012).

  Access of information and successful knowledge transfer is rarely one dimensional – it occurs as part of an information and knowledge web (Easdown & Starasts, 2004), which can include local newspapers, agricultural magazines, feedback from peers and professional groups and industry updates. For information to be incorporated into this web it is important that it is as inclusive, easy to access and navigate and be as user friendly as possible.

- Provide education on how to use the information technology. Levels of technology literacy vary (see below), with older agriculturalists likely to have lower levels of skill both in use of technological innovation and also in the application of findings drawn from open data. Thus, there is the need for education, but this should not be formal or rely on traditional approaches to education as this has proven to be ineffective in the past in achieving behaviour change with many of the target group for technological innovation in agriculture. It has been identified that there has often been a mismatch between how information is delivered and the learning styles and approaches of the recipient group (Easdown and Starasts, 2004). On particularly effective strategy is that of extension training from researchers to end users (including farmers) (Baumgart-Getz et al., 2012).

Extension training is particularly valuable when characterised by the following points.

- The adoption of a social learning approach. As identified previously, networks and links are critical parts of decision making in the agricultural sector. Thus, key strategies in this approach include ensuring that supportive peers are in place, that training is personalised, and that ongoing support is provided through the mechanism of mentoring (potentially online to build skill in technology while receiving support). Importantly, social learning techniques legitimise information and knowledge building through individuals learning from the experiences of those in their network based on their experiences in the use of technology. Social learning reflects experience and the sharing of this, therefore, extended uptake across networks hinges on evidence of positive (and measurable) outcomes for the individuals/groups that are sharing their experiences (Blackstock et al., 2010; Chatzimichael et al., 2014)

- A capacity-building agenda. In this approach, there is a strong emphasis on the identification of specific key issues that are a priority for that local context, and for the on-farm environment (Reardon-Smith et al., 2015; Vanclay, 2004). Extension practices use the key issues and priorities as a mechanism to build capacity on what is available through technology to support targeted decision making. Once this has occurred successfully in regard to priorities, then the end user has an enhanced capacity to apply the approaches and techniques with alternatives issues, priorities and situations as the need arises.

- High levels of interactivity. When extension training is provided in relation to research and technological innovation, this should occur using the tools of participatory workshops (Attanandana et al., 2007) and interactive forums so that individuals have the opportunity for effective and supported applied learning – a defining feature of successful adult learning approaches. It has been suggested that engagement with, and reflection of, natural modes of learning through experience and discussion should be the preferred approach (Reardon-Smith et al., 2015), and this is reinforced in studies that clearly show that, in terms of technology, farmers are most likely to build skills through application. The opportunity to use and experiment with technology provides a parallel opportunity to build familiarity with the features that make it unique. This means that knowledge building on both content and usage techniques are built in parallel, allowing skills in, and understanding of, the value of technology to be maximised (Chatzimichael et al., 2014).

  This type of capacity building is significant in that end users are able to use an innovation effectively and, through this process, are more likely to feel confident in the value of information sharing and knowledge transfer. Success in using one innovation as a tool to be adopted to support practice decisions has flow-on effects in terms of how end users view the potential of technological innovation. Importantly, the end user can become a champion for adoption and application.

Linked to this previous point, available research highlights the importance of ensuring that a champion is identified within the local community to support and facilitate adoption of these types of change strategies. As has been identified across various sectors seeking to build uptake of innovation, a local champion is a critical resource (Dopson et al., 2002; Ferlie et al., 2001; Straith et al., 2014; Strong & Irani, 2011). Without this, particularly in industries and sectors where networks and webs of influence are a recognised component of the decision-making process, the successful uptake of technological innovation becomes more difficult.

Extensive research on the role of champions for change management in recent decades has found that the champion needs to have a number of key characteristics. These include: 1) being part of established networks; 2) holding high levels of trust amongst key groups and individuals; 3) having a commitment to, and a strong belief in, the innovation being introduced and promoted; 4) having levels of expertise in the sector and being allocated an

associated level of respect as a result of their expertise in, and commitment to, the sector; and, 5) having the capacity to reach a number of groups and individuals and provide some level of support in implementation and roll out of innovation. Grower groups and agricultural consultants are often a valuable source for this type of support. This is because they meet many of the criteria outlined above and are often key players in the development of localised research and in industry enhancement – a factor that builds trust and support within extended networks (Al Musawi, 2014). These are the groups and individuals who provide a strong starting point when seeking to identify and support an innovation champion for adoption and integration of technological innovation in the practice environment.

The identification of champions and the building of a strong commitment amongst them for innovation is closely tied to the forging of a connection between those involved in the development of the innovation (the researchers) and the groups that are the target of the innovation (the end users). It is critical that those who are undertaking the implementation work to market, support and nurture the innovation. This needs to continue until the value of the innovation and its position as a support for practice enhancement within the marketplace becomes evident (Nain et al., 2012). At this point the innovation will move from the potential to the practical.

2.2.1 Key insights from the literature on information and knowledge building

The literature in this section highlights some key factors pivotal in building an understanding of how to increase information access and knowledge building within the agricultural sector. A summary of the key points of relevance to this research study is provided here.

- The provision of adequate information is critical to support informed decision making and the attainment of best outcomes. Within this context, technology provides an innovative means for increasing the capacity for accessing information, transferring knowledge and enabling individuals to retain high levels of control over the knowledge-building and decision-making process.

- Lack of information disadvantages decision making through:
    - reducing the capacity to build a greater level of understanding of research-driven industry best practice;
    - removing levels of autonomy in a rapidly growing era of knowledge building; and
    - limiting understand of the value of technological innovation and, linked to this, limiting adoption of innovation and change that have the potential to enhance practice outcomes.

- A number of strategies have been found to be particularly valuable in driving and supporting changes in behaviour and attitudes as they relate to technology, information access and knowledge transfer. These are:
    - providing information that is of a high quality;
    - ensuring that content is updated on a regular basis, is easily accessible and has high levels of flexibility and reliability;
    - ensuring that delivery techniques are user friendly and relevant. This needs to occur from the outset for effective engagement to occur. Re-engagement with an innovation once an initial introduction has captured and subsequently lost the audience is very difficult to achieve;
    - working closely with end users to ensure that they are active participants in the development of the innovation and in the processes of implementation, review and expansion. This will enable the retention of control over the knowledge building process – an important part of stakeholder identity;
    - ensuring that the information provided has local relevance and applicability and that innovations are closely aligned to sector priorities and industry imperatives, with overt and observable advantages to uptake; and

  - developing a resource that uses plain language and concepts that are simple and easy to understand. Academic language, complex scientific concepts and the lack of a clear link between theory and practice will all act as barriers to uptake.

- The provision of informal education is an effective strategy for skill building that will support and facilitate access. For this to be successful, the skills training provided must:

  - adopt a social learning approach in which networks and peer relationships are used to highlight the potential of technological innovation and to share successful experiences as they relate to implementation, impact and outcome; and
  - be underpinned by a capacity-building agenda – focusing on effective and applied learning so that skills that are learned are transferable across different types of technology and different priority enterprise issues. This training should be characterised by high levels of interactivity.

- At the centre of the capacity-building process should be the identification of champions to promote and advocate for the uptake of the innovation. These champions need to be drawn from the relevant web of influence of the potential end users. These are people who are trusted, respected within their sector and people who have used the innovation successfully – or who can advocate for the potential of the innovation to achieve positive and sector-enhancing outcomes. Closely linked to the building of innovation champions is the building of a connection with the innovation developers (the researchers). A strong link between innovation developers and end users helps to create a place in the market, and an increased understanding of its potential for the practice setting.

These findings relating to information access and knowledge building provide further insights into the factors that need to be taken into consideration in the implementation of technological innovations.

The final area for review in building this knowledge base relates to technology in agriculture.

2.3 Technology in farming

The adoption of technology generally brings with it some slightly different issues to the adoption of innovation, although the two are closely related: many of the issues that impact the uptake of innovation are also influenced by the levels of use of, and confidence in, the technology itself. Research has identified that age, level of education and socio-economic status of potential users play a role in determining levels of use and uptake of technology as a practice modality in the farming sector (Perlgut, 2011;Rao Hill et al., 2011).

Instances in which there is a greater level of economic security, particularly when there is a younger (and potentially more educated) cohort of farmers running farming enterprises, create an environment in which technology is assessed as something likely to enhance productivity. The time needed to trial and explore ideas and innovations that require proficiency with technology is more readily allocated when there is an understanding of this type of potential and some flexibility in the timeframe for economic return and a greater margin for risk absorption (Ommani et al., 2009). When there are lower levels of economic stability then there is a stronger drive for immediate action, characterised by readily-identifiable practical outcomes. Younger farmers are often the leaders in the change process, and, regardless of economic stability, younger farmers have been found to be more likely to try technology and feel comfortable in its use. In contrast, older farmers are more likely to adopt known or familiar methods with proven efficacy and reliability (Nguyen et al., 2007). This is an important finding given that proficiency with information technology has been directly correlated to uptake of technological innovation (Woodgate & Love, 2012).

Internet access (or lack thereof) is a significant problem in the agricultural sector. Research has identified that internet capabilities remain problematic in rural communities – manifesting as patchy connectivity, 'not spots ', lower speeds and poor quality of broadband (Rao Hill et al., 2011;Roberts et al., 2015). Although internet access

is often identified as an ongoing issue in rural communities (Al Musawi, 2014; Easdown & Starasts, 2004; Roberts et al., 2015) this is not the principal issue in terms of farming and technology. It is the lack of skills that individuals have in the use of information technology that has been found to be notably more important in determining levels of uptake of technology (Anastasios et al., 2010). In reality, these are interrelated issues – if you have access, you have a greater capacity to build skills. If it is not possible to easily access internet and be confident in continued reliability, it is a logical consequence that this will act as a disincentive to build and enhance skills. However, if the skill base in how to confidently use technology is missing, availability of internet does not act as a stand-alone incentive to use seek out technological innovation as a tool in decision-making. Thus, although good internet access is a good start, for those who do not have sufficient confidence due to age, level of education or socio-economic status, it is not the only determinant of uptake.

As identified in the previous sub-section, shifts in skill building require an environment of social learning that involves appropriate training, support through networks and peers, and capacity for participation. As age has been identified as a potential issue in terms of willingness to adopt technology and, associated with this, innovation (Aubert et al., 2012), age is something that needs to be factored into response strategies. This is especially important given the aging population within the agricultural sector. Age influences learning styles and responsiveness to becoming involved in training regimes (Lamb, 2012), so needs to be a point for reflection when trying to strengthen the link with technology in this industry sector.

This does not mean that it is not possible to introduce and build technological competence in the farm environment. Change is clearly possible even in environments in which traditional approaches to information gathering and knowledge building have been the norm. The strategies outlined in the previous sub-section of this report relating to trust building, applied learning and use of networks, are all approaches likely to be successful when working with this particular group.

A particular focus also needs to be given to working in further building proficiency in the use of technology with women in agriculture, as they have been consistently identified within the literature as having a higher skill level in the use of technology, and as being more responsive than men to accessing information that is likely to inform and support farm decision making (Basu & Chakraborty, 2010; Easdown & Starasts, 2004). This is an important finding in targeting training and development for the implementation of technological innovation.

The final recurrent issue to emerge across the literature in relation to technology and farming relates to the efficacy of innovation, and the impact that this has on uptake. As identified by Lamb et al. (2008), adoption remains closely tied to the extent to which the innovation is able to meet the claims it has made around capabilities and benefits. Achieving this alignment between expectations and capabilities can be difficult as there are a vast array of issues that need to be successfully accommodated when attempting to use technology for decision support. There is the social, economic and environmental context, existing stakeholder knowledge, the nature of the farm enterprise, and the unique characteristics of the specific sector of the agricultural industry. Acknowledging this complexity, when there is a gap between the expectations what is actually delivered, then the likelihood of uptake is low, particularly if there is a requirement for skill development in the use of technology.

Assessment of shortfalls in the technology can be made based on a number of factors. These include:

- how easy it is to navigate through the technology to find specific answers;
- how useful these insights are perceived to be for improving farming outcomes;
- whether it is possible to answer research questions and build knowledge about priority issues within a particular catchment; and
- whether the technology will provide viable solutions to addressing priority issues for the community that is accessing it (Aubert et al., 2012).

Conversely, if the potential usefulness and usability of the technology is readily identifiable by potential end users, many of the issues relating to access, skill base and competency with information technology will have a diminished

impact. This is because individuals will proactively work to address skill base and competency shortfalls in the interest of measurable benefits to the farm enterprise.

In aligning the issue of technology and the uptake of technological innovation, there are a number of synergies that have provided an enhanced knowledge base to inform the data collection and data analysis process for this current research study. These are discussed below.

2.3.1 Key insights from the literature on technology in farming

A number of key emergent themes were drawn from previous studies relating to technology in farming, these are listed below.

- The level of education and socio-economic status of potential users play a role in determining levels of familiarity, competence, use and uptake of technology.
- Those users with greater economic security are more likely to embrace the potential of technology to enhance returns. Correspondingly, they are likely to be more flexible in the timeframe they allow for economic return from a technological investment.
- Younger farmers are more likely to try technology, and feel comfortable in its use. They are also more likely to make the conceptual link between competency in the use of technology and the achievement of greater levels of success in the application of technological innovation as an integral part of the decision-making process.
- Internet access remains a major issue in rural and regional communities although, while problematic, access issues are secondary to technological skill issues. For example, no access does not preclude the existence of skills to effectively use technology (when available), but in the case of a lack of an adequate skill base, access becomes a secondary issue. Effective access is a good start but for those who do not have confidence in the use of technology due to age, levels of education or socio-economic status, it is not the ultimate determinant of uptake.
- Age influences learning styles and responsiveness to becoming involved in training regimes. This subsequently impacts on the capacity to build skill development in the use of technology for some members of the agricultural sector.
- Social and interactive learning techniques provide a proven approach for skill building in the use and the application of technology for farm practice and decision making.
- Women in agriculture have higher levels of skill in technology and in the application of technological innovation. Within this context they provide a valuable resource for supporting uptake.
- There needs to be a strong alignment between the claims of technology and its demonstrable capabilities. Any gap between what is claimed and what is delivered will diminish levels of uptake of technology to access contemporary innovation. This is likely to be particularly problematic when skills in the use of technology are low.
- Assessment of shortfalls in the technology are usually related to (i) how easy it is to navigate through the technology to find specific answers; (ii) how useful these insights are perceived to be for improving farming outcomes; (iii) whether it is possible to answer research questions and build knowledge about priority issues within a particular catchment; and (iv) whether the technology will provide viable solutions to addressing priority issues for the community that is accessing it. If these factors are addressed, many of the barriers to the uptake of technology are likely to be diminished.

2.4 Summary on the literature review and future research

This summary of available literature highlights that, although there is a growing body of evidence around the role of information and knowledge building in enhancing user competencies, the extent to which this actively shapes farm management approaches and decision making for end users remains largely unknown. As there has been limited research measuring the correlation between the use of information technology, knowledge building and sustained shifts in decision making to achieve practice change, there remains a clear debate around the medium-

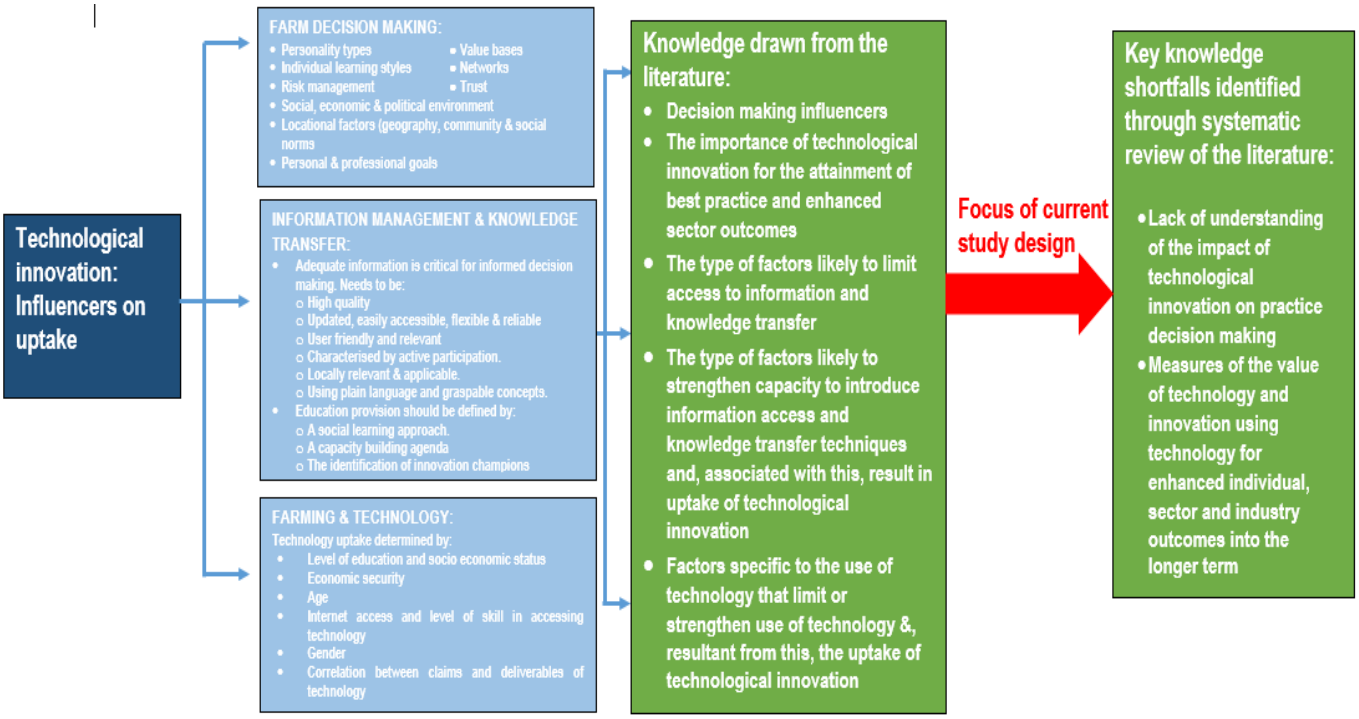
and longer-term value of technological innovation. Access is viewed as central to empowering individuals to make informed decisions, but how this enhanced capacity translates into shaping the practices of individuals remains unproven. This is particularly true in regard to end users who have not traditionally used technology as a tool for informed decision making – such as those within the primary production sector (Ali & Kumar, 2011; Barnesa et al., 2013; Dalgliesh et al., 2009).

Some work has been undertaken to show that technology has, to this point, failed to bring about notable improvements in terms of increased adoption of innovation on farms (e.g. Chowdhury &and Odame, 2013), but there have been few studies that have provided insights into the impact and efficacy of these types of supports in changing practice or evidence relating to the benefits of technological innovation for achieving measurable improved productivity, practice and social outcomes (VAGO, 2015). It has been recognised (Salim et al., 2015) that the role of technological innovation in agriculture has been under researched to date and that it is critical to build a greater understanding of this area at a range of levels. These foci are particularly important given that the continuing debate around the value of technological innovation. The recent report from the Victorian Auditor General (VAGO, 2015) identified that:

> *Victorian agencies and entities are currently not in a position to assure Parliament and the Victorian community that their ICT investments have resulted in sufficient public value to justify the significant expenditure of taxpayers' money. Currently agencies and entities are not only unable to demonstrate the achievement of expected benefits from ICT investments, they are also, in general, unable to comprehensively report actual ICT expenditure, or the status of projects.*

The insights gained through this review, and the clear need for greater research in an area with a significant evidence shortfall, are the drivers for the development of the research design outlined in the following sub-sections of this report. The links between the literature review, the identification of information shortfalls and the focus of the current study design are detailed in Figure 3.

Figure 3: Conceptual links between literature and study design



Section 3. Study design and methodology

3.1 Rationale for research

The issues that were identified within the literature review and summarised in Figure 3, highlight the complex nature of decision making and the need to better understanding individual behaviours, the prevalence of certain personality types in the agricultural sector, influencers on decision making and specific drivers for uptake of innovation. The requirement for exploration in these areas clearly establishes the research paradigm most likely to be effective for this study.

The nature of the agricultural community, and the extent to which OFT is aiming to work to enhance options and opportunities for this sector, the complexities associated to working with this sector and the issues identified as problematic in relation to uptake of innovation (the defining element of OFT) all provide a clear direction for the development of the research logic for this study.

The insights being sought to address existing knowledge gaps are experiential in nature and can be gained only through the application of a qualitative methodology. A mixed-methods approach can be applied to the research to capture the quantitative elements of the project (such as usage data, quality ratings and user type) the overall logic must be drawn from the interpretivist school. This is because the focus is on the human experience, and individual interpretation of this experience. Therefore, an approach that seeks to overtly acknowledge that worldviews, experience, background and beliefs have a significant impact on individual perceptions of, and subsequent responses to, a range of issues must be taken (Creswell, 2003; Crotty, 200; Mertens, 2005). It is within an understanding of these individual perspectives that a current knowledge gap can be addressed, and processes to enhance implementation and uptake of OFT be established. Although this is not a traditional scientific approach to data collection and analysis, this research logic best meets the parameters of knowledge being sought. It is acknowledged that this approach gives rise to questions relating to the validity and generalisability of qualitative over quantitative techniques and these are addressed in detail in Section 3.3 of this report.

The most appropriate methodology (research design strategy) for this interpretivist study is a case study approach. Applying Yin's framework for case study design (1984; 1994; 2003; 2009; 2014) this study has examined OFT as a single case with multiple levels of analysis. As there are already a number of grower group participants for OFT (each of which represents a potential study group), and the project continues to be rolled out, there is the capacity for the study to be implemented at multiple levels: grower groups, planning (GRDC panels), sector support (agricultural consultants and research organisations), and with individual growers.

As a single case study with multiple levels of analysis, research into OFT will provide case-specific empirical evidence on implementation, uptake and impact of OFT. Importantly, these findings will be embedded into a larger multiple case design relating to open data access, decision support and practice change. This larger design, and the place of OFT research within the context of the larger design, is also explained briefly in sub-section (3.3) of this report. Details of the research design strategy specific to the OFT case study are provided below.

3.2 The OFT research design strategy

The research project involves the collection of data from a range of research participants. Data were collected from grower groups from all states of Australia from which farm trial data has been drawn (WA, VIC, NSW, Qld, SA and TAS), from GRDC panels across the country, from GRDC staff, as well as from agricultural consultants and from growers.

A key strength of this research design strategy is that data collection will be repeated at 12 month intervals across four data collection waves. This will allow for comparative data to be gathered and for this to occur across a longer timeframe – providing an extended and comparative core element to the study.

3.2.1 Data collection timeframes

In order to track changes over an extended timeframe, data will be collected in a series of data collection waves. These will occur in the following sequence:

- Wave 1: at early implementation (this current study);
- Wave 2: 12 months after completion of Wave 1;
- Wave 3: 24 months after completion of Wave 1 (12 months after completion of Wave 2); and
- Wave 4: 36 months after completion of Wave 1 (12 months after completion of Wave 3).

Given data collection and analysis and write-up requirements, it is expected that the full research process, across the four waves of data collection, will take a total of 4 years from commencement to completion. Data collection processes will be undertaken in a repeat sequence for each of the data collection waves.

Each of the data collection waves will result in a wave-specific research report. A final report, incorporating data across all 4 waves, is to be completed by January 2020. This current report provides the findings from Wave 1 research.

3.2.2 Data collection and analysis techniques

Data collection for each of the research waves is comprised of the following components.

- An online survey. The survey examines issues of usage, quality of data, knowledge building and knowledge application in the practice context. It also examines issues relating to data input and the quality of the data contained within the portal, as well as data improvement potential. A copy of this online survey is included as Appendix 1 of this report.

- Interviews with identified key stakeholders including researchers within the crop research space, agronomists (including expert agronomists), industry, landholders/grain grower group members, panel members, GRDC (to determine the impact of OFT on how they shape overall research direction). Three of those involved in interview (8% of the overall interview sample size) also completed the survey although the opportunity to complete the survey was offered to all interview participants. These interviews examine issues relating to project establishment and project implementation, barriers and enablers for uptake, perceptions around the role of the portal in knowledge building, practice impacts, social elements, productivity enhancement potential and stakeholder input into the data sets that comprise OFT. They also track location and context-specific issues and their impacts. A copy of this survey (including contextual differences based on research participant role) is included as Appendix 2 of this report.

- Portal usage data analysis. Google Analytics was used to measure a range of factors specific to usage, access and frequency across timeframes. This data (in its entirety) will be reviewed at each of the data collection points for surveys and interviews.

- Document analysis. All documentation relevant to the project is reviewed using qualitative data analysis (content analysis) techniques to identify trends and themes of relevance for informing the study.

- Email feedback analysis. Since establishment of the OFT project there has been a clear mechanism for the provision of feedback to the OFT team in relation to technical support, problems with uploading or accessing data, general and specific questions and ideas generation. Analysis of email requests and CeRDI staff responses to requests forms part of this data collection method.

In addition, at each point of the data collection process, an extensive literature review is to be undertaken on the themes of (i) decision making influencers and drivers; (ii) uptake of innovation; (iii) the impact of technology on practice change; and (iv) shifts in contemporary agricultural support structures, particularly in grains development and research. This will also include a review of research and development priorities in the sector. This ensures that all research can be reviewed against the latest evidence base while a repository of evidence-based knowledge on key external issues and developments in this field of research and practice is built.
These data techniques were used in Wave 1 data collection (with findings outlined in this current report) and will be reapplied in each of the four waves of data collection.

Data analysis has been conducted, and will continue to be conducted, using established techniques for qualitative and quantitative data analysis. Collected qualitative data (interview, written components of surveys and document analysis) was managed and analysed using structured coding and coding trees, which provided the basis for theme identification across data. Nvivo will be used for data management and storage. Statistical data was collected and analysed using Excel. SPSS will be used once data volumes increase as a result of additional waves of research.

The current study does not, and will not in future data collection waves, include a control group. This decision has been made to accommodate the large scale of the proposed study and the fact that research resourcing cannot accommodate an even larger scale of data collection than that already proposed. The lack of a control group is mitigated by the fact that data collection involves both established and new project-participant groupings, thereby maximising comparability of characteristics across data pools and strengthening the capacity to map themes across multiple data collection points.

An additional strategy to maximise data validity for this study will be the triangulation of data at multiple levels. Triangulation has occurred, and will continue to, occur in the following ways.

- Data methods. A range of methods were used in the collection of data for the study. The collection of data through multiple approaches including interviews, surveys, service usage analytics and document analysis ensures that the capacity for bias or methodological shortfalls is minimised as the scope of data allows for cross-method data testing.
- Data source. Feedback has been, and will continue to be, sought from a range of end users including farmers, grower groups, agronomists, GRDC, researchers and consultants. This will ensure that data trends across groups can be identified, discoveries that may be unique to one particular group can be tracked, and consistent trends across groupings can be readily themed.
- Research study design. A range of approaches will be applied to the data collection process. This will maximise the capacity to track data differences and similarities across sites, groupings and time points. The approaches to be used are:
    - cross sectional (examining findings across a series of specific points in time);
    - variable uptake points (collecting data from groups at different points of involvement with OFT and at set intervals across an extended timeframe allows for comparative analysis of uptake point differences); and
    - multiple waves of research (examining data across an extended timeframe).

The use of data triangulation techniques maximises data validity and ensures a strong body of primary data from which to draw conclusions relating to the implementation and impact of OFT.

The aim of the collection and analysis of this body of primary data is to build evidence relating to levels of knowledge of OFT, as well as shifts in behaviours and attitudes in practice approaches as a result of OFT. This focus will be applied at the individual research participant level, and later, once this body of evidence is consolidated, at a broader systemic level.

To this end, the study analysis for this research will, across the completion of the four waves of research, be on the impact of the innovation on the following areas.

- Knowledge impact. This will measure and provide research insights in relation to:
    - levels of end user knowledge about the OFT as a stand-alone initiative;
    - the types of advanced technology approaches and techniques most likely to enhance knowledge building outcomes for end users;
    - the level of use of OFT and any usability issues for end users;
    - issues relating to access to the OFT and broader issues of accessibility and how this impacts on end users;
    - the quality of the content – including building insights into the strengths of the initiative and any areas requiring change; and
    - the profile of OFT users including the most common user types and what drives their choices relating to usage.

- Behaviour impact. This will measure and provide insights in relation to:
    - shifts in decision making and practice outcomes as a result of OFT;
    - the extent to which there has been integration of OFT in planning and decision making;
    - shifts in social interactions and outcomes at the community level as a result of the OFT resource;
    - any shifts in productivity outcomes resulting from OFT; and
    - measurable changes in planning process as a result of OFT.

- Attitudinal impact. This will measure and provide insights in relation to:
    - the extent to which end users promote OFT as a mechanism for knowledge building, decision making and behaviour change;
    - shifts in perceptions around role of technology in decision making and knowledge building that have occurred as a result of involvement with OFT; and
    - shifts in end user input into (or perceptions relating to their capacity to input into) OFT process and content.

To guide the study at each of the waves of data collection, and to ensure consistency and comparability of data across groupings, a series of research questions has been developed. Their development has been based on research knowledge gaps (as identified in the literature analysis) and as appropriate to the interpretivist tradition (as discussed in the study design rationale).

Five overarching general research questions have been developed, each supported and consolidated through a range of subsidiary questions. Provided below are the general questions, with the complete schedule of both general and subsidiary questions provided in Appendix 3.

3.2.3 Research questions

1. What strategies in implementation of Online Farm Trials have worked most effectively to support and facilitate data access to the maximum numbers of potential end users?

2. What approaches applied during the eResearch relationship were found to maximise stakeholder input to the knowledge building process?

3. What have been the key impacts of Online Farm Trials for a range of key stakeholders, including growers, farming groups, researchers and agronomists?

4. How have Online Farm Trials effectively captured data that can be used to build evidence based knowledge repositories to maximise access and minimise research duplication over the longer term?

5. In what ways does open data access, as provided through the tools and mechanisms of eResearch, impact on decision making and facilitate practice change?

Although these questions are specific to OFT, they are closely aligned to the research questions that have been developed for the larger research study being undertaken by CeRDI (referred to briefly in the previous sub-section). The scope of this larger study, and the links of this to OFT is explained in greater detail in Section 3.3 of this report.

Once data has been collected from individual research participants in regard to the foci of knowledge, behaviour and attitudes, the research study will be seek to measure the overall impact of the innovation using a consolidation of the analysis of participant feedback across all four waves of data collection. This will be used to place impact within the context of a research typology that has been developed for this purpose.

3.2.4 Definitive measure of success: a research typology

As part of the commitment to building a high quality evidence base on the impact of technological innovation across a range of domains, CeRDI has developed a typology for rating and ordering the impact of innovations. This typology has drawn from a range of literature insights including the work of Hawe et al., (1990) relating to measurement of programmatic impact, the work of LaBonte and Laverack (2001a; 2001b) on the measurement of the successful building of social capital (relevant within the context of this sector given the emphasis placed within the literature on social networks, trust and the web of influence) and the work of Kirkpatrick (1994; 2005; 2007) on individual learning and behaviour change.

The typology provides the framework against which to measure gathered data to determine the extent to which a particular initiative is having an impact, at a range of levels, for the end users of the initiative under examination. It also facilitates the measurement of the extent to which an initiative is achieving the purpose for which it was established. In this current study, it will facilitate the measurement of the success of OFT as a tool to support farm decision making.

There are three levels within this typology, operating as a hierarchy of impact measurement. These are as follows.

Level 1: The *Primary Impact Level* refers to emerging insights and trends relating to the innovation. Attainment of this level is commonly determined by analysis of usage levels and participant feedback about data currency, quality and relevance. It is also related to user type and the reasons for use of the resource.

As this level is generally assessed in the early stages of establishment of a new technological innovation, it considers key establishment process issues. Questions asked are in relation to factors such as whether the target audience is being engaged, whether the way the innovation has been established is as effective as it can be, service quality and whether there is positive feedback being provided about the resource. This represents an important measure against which to determine initial impact and to make suggestions for change.

As the data is gathered within the first 6–12 months after initiation of the innovation, it is not possible to build an evidence base on sustainability of impact at this level.

Attainment of a Level 1 impact provides no evidence relating to changes in behaviour or practice. It does, however, provide some initial insights into the use of the technological innovation and the factors that have worked successfully during implementation. In an extended time study (where data will be collected at multiple points over a longer timeframe), Level 1 builds comparative baseline data against which to measure subsequent data collection, and against which any shifts in practice across end user groups can be tracked.

Level 2: The *Practice Impact Level* is based on the extent to which the technological innovation is being utilised within the industry, sector, community and/or workplace to aid in decision making, to exchange information and knowledge and to shift perceptions. At this level, where relevant, it is possible to measure whether the innovation is viewed by end users as resulting in a consistent modification of how they, their industry, sector, community or their workplace might address a particular issue. This level shifts impact measurement to a higher order than that measured with Level 1. This is because Level 2 impact provides an indication of the extent to which the technological innovation (in this case OFT) has begun to, at the individual practitioner level, become imbedded as a resource to support decision making or can be linked to a shift in economic, social, cultural or community outcomes.

Level 3: The *Sector Impact Level* is based on the extent to which the technological innovation has become embedded as integral to activities and decisions that shape the sector – the industry, the government body, the community and/or the research community. At this level the impact of the innovation can be seen to have moved beyond initial interest and usage and beyond shaping individual planning decisions within the sector.

Attainment of this level of impact will mean that the innovation has been integrated as a tool that the sector itself views as part of the planning, decision making and benchmarking resources that are available for sector development, engagement and research.

The above typology will be applied against findings in the current and future waves of research involving the OFT project. This typology provides the framework for classification of levels of impact as a result of the innovation and allows a measure of the extent to which that impact has become embedded, and changed practice and behaviour.

In order to consistently track the ways in which each level has been achieved, each of the levels (1, 2 and 3) are rated using a three-point rating scale. The rating scale was developed based on an extensive literature review on the issue of measurement of capacity building indicators and then finalised through a consultative process involving three senior researchers at federation University Australia. Ratings are given against each of the elements that have been identified as relevant to the level of impact being assessed. For Level 1 (which is the focus of this current Wave 1 report) the elements being rated are:

1. level and frequency of usage;
2. assessment of content quality;
3. usability and navigability;
4. usefulness of content;
5. level of support provided in establishment and usage;
6. participant experiences of the innovation;
7. trust in the resource; and
8. potential for further development relevant to the sector.

As data relating to each of these elements are analysed and presented, a rating out of three (3) will be given to the element that has been examined. These ratings will be provided at the end of each section of this report – at the end of the summary of findings. An overall outcome across the elements will then be mapped within the Study Conclusions and Recommendations section of the report. This will enable provision of a clear visual representation

of areas that will require additional work to maximise attainment of the objective for which OFT was established. The criteria for ratings allocation is detailed and provided in Appendix 4.

Given that this first wave of data collection and analysis focuses on examining the impact of OFT at a point of initial establishment of the portal, there was the potential that the portal had not yet reached a sufficient point of programmatic maturity for consistent themes relating to impact to have emerged. Consequently it was decided that, prior to commencing the research process, an analysis be undertaken on point of implementation maturity and level of innovation development in order to determine preparedness for an impact analysis across the levels of impact.

3.2.5 OFT readiness for research: an evaulability assessment

In determining the readiness of a program or an innovation for impact research, it is critical to undertake an assessment of readiness, and the most effective mechanism with which to undertake this may be found in the work of Wholey (1979; 1994). Wholey coined the term 'evaluablity assessment' to define the assessment of the readiness of a program for research and impact analysis

A post-implementation level of readiness for research cannot be assumed because programs roll out and work toward meeting their establishment goals at different rates. An impact assessment undertaken too soon after initiation can show that the program has been ineffective, and if this assessment is made it is possible for the longer-term scope and aims to be achieved, then the results will be flawed. In this instance, the program has not failed but rather, the timeframe for assessing success or failure was premature.

Evaluability assessment requires that a structured assessment of a range of factors be undertaken including, but not limited to whether:

- there was successful alignment with set long-term goals during initial implementation;
- the innovation, in the way it has been marketed and rolled out, has maximised its capacity to reach the full target population for which it was established;
- within the existing participant pool, there is the capacity to gather fully representative data across the potential service user population;
- there is a clear alignment between resource allocations and targets set for the initiative; and
- there is a measurable correlation between implementation and the vision and goals set in the original design.

When these issues have been addressed, then the innovation is at a point at which a full impact assessment can be made with confidence that data gathered are representative of a mature and developed initiative.

An evaluability assessment was undertaken with the OFT team and involved: (i) an initial review of usage levels; (ii) a small-scale review of point-of-development against longer-term goals and vision; and (iii) discussions with the OFT team and key stakeholders from the pilot grower groups. This process found that although significant work has been undertaken, program development was only in the early stages, and a large pool of data still needs to be included to broaden the scope of OFT and align it with the longer-term goals and vision. To assess OFT for impact across all potential levels of impact (Levels 1, 2 and 3) would result in an assessment of attainment that would not be representative. This is because full implementation could not have occurred within the available timeframe. As a result of this work, it was determined that a Level 1 (Primary Impact Level) should be targeted for assessment through the research process. Consequently, this first wave of research focuses specifically on Level 1 impact, and all data were collected, analysed and presented against the criteria of relevance for this level of impact.

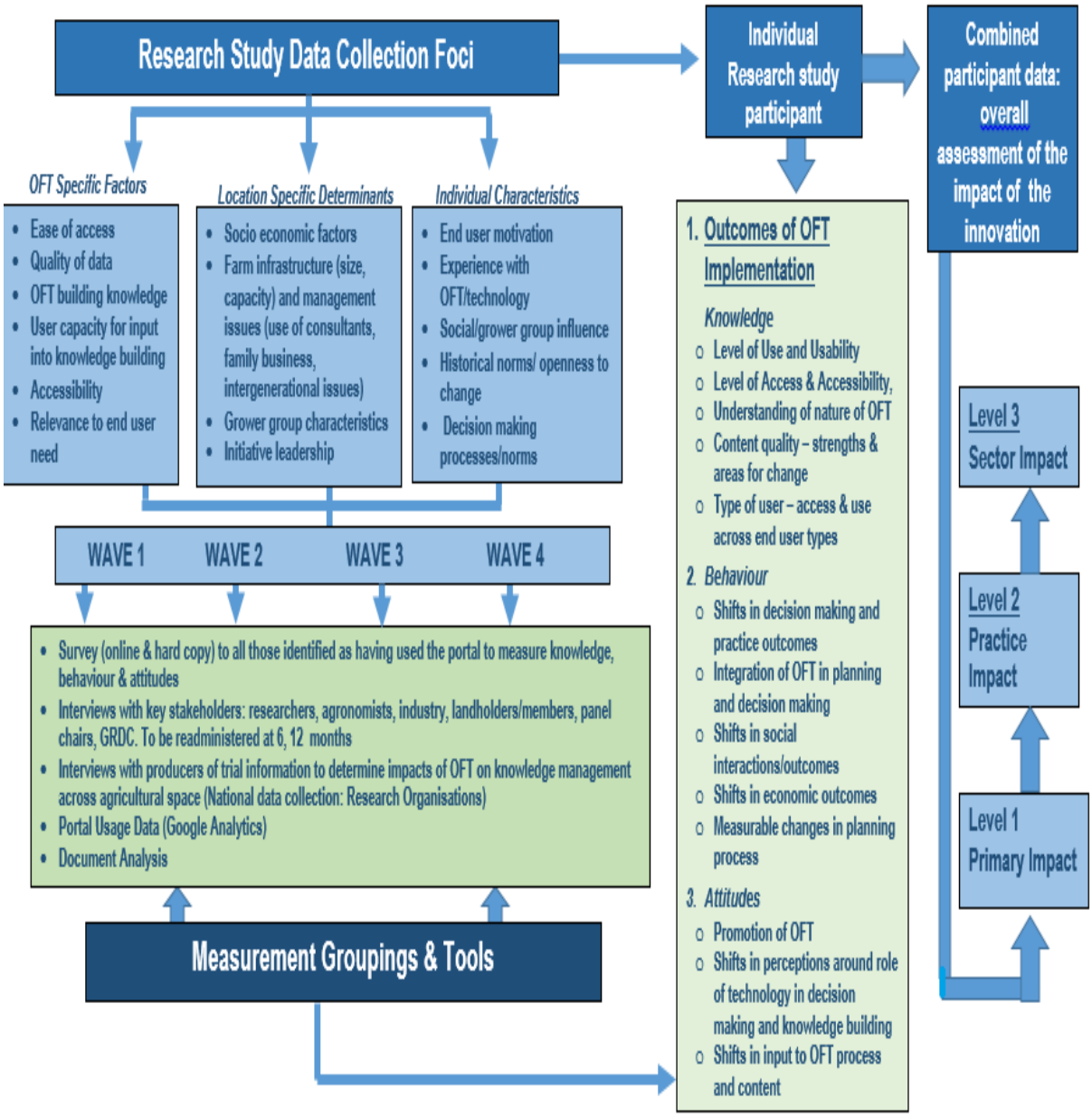
3.2.6 Ethics

Ethical approval appropriate for research involving individuals was gained from the Human Research Ethics Committee of Federation University Australia and principles guiding the data collection and analysis process were observed to serve the best interests of all participants at each stage of the research process. Ethics Approval Number A15-086.

3.2.7 Section summary on conceptual framework

In summary, the study design for the OFT Wave 1 Research Project has mapped out the study rationale, data collection tools, timeframes for collection, research questions and links to both individual and systemic outcomes measurements. These components, and the links between them, create the conceptual framework for this study, which are mapped and presented diagrammatically in Figure 4.

Figure 4: The conceptual framework against levels of impact



3.3 OFT within a broader context: multiple case design

Within the broader context of innovation and sector development and change, a repetitive emergent theme has been that there is the lack of an evidence base for the impact of open data. This is despite growth and expansion of open data access across a range of industries and communities (Keserě & Kin-sing Chan, 2015; Uhlir et al., 2010). The call for an evidence base relating to the value of open data has been strong at the national and international level, and was a point of primary focus at the October, 2015 RDC Transformative Technologies workshops held in Sydney. It is now to be included in the Action Plan for international Co-operation to be developed resultant from the 2015 Ottawa International Open Data conference (Action Area 7: Measuring Open Data).

Importantly, this call for the development of overt measures around the value of open data (for business, for community, for decision making and for practice) has been underpinned by a call for the use of both qualitative and quantitative evidence gathering methods to allow for informed analysis and practice change measurement (International Open Data, Ottawa 2015). Further work (Arnott & Pervan, 2005; 2008; 2014) has presented arguments that one shortfall in the technology-based research arena, particularly in decision support, has been the lack of case studies and the use of qualitative social theory. This is a significant development in an evidence-based research environment in which the leaders, whose work is classified as being of a 'gold standard' of research evidence, are the scientific disciplines. The positivist research paradigm is viewed as objective, based on universal laws and as having high levels of generalisability. These are critical elements to consider when introducing research innovation, as they facilitate both uptake of the innovation and the acceptance of its value within the research community. The link between the application of a positivist/scientific approach and perceptions of research credibility is strong. The approach offers objective measures and structured impact indicators – benefits that can neither be negated nor ignored. The shortfalls of this approach are that pure science does not facilitate the examination of the social impacts of an innovation, neither does it capture the drivers for behaviours and attitudes relating to particular innovations. Geographical location, context, beliefs and tradition play critical roles in achieving a sustainable impact from innovation. Gaining insights into these areas, and how they shape uptake of innovation, often depends on the capacity for individual end users to tell their stories. It is these stories, and the insights they provide, that play an important role in shaping forward planning and development in the eResearch arena. Just as the positivist approach is grounded in objectivity and measurable evidence, the interpretivist paradigm is grounded in subjectivity and the exploration of user experience.

The multiple bounded system design (MBSD) provides a mechanism through which to marry some of these differences and to enhance generalisability when building an evidence base within the framework of the interpretivist research paradigm.

The MBSD refers to case study research (each bounded system is a case). As has been discussed in sub-section 3.2 of this report, the goal in case study research is to understand the boundaries and the complexity of behaviour patterns and approaches in relation to a particular issue(s), intervention(s) and/or innovation(s). It is a methodology that allows for experimental research that 'investigates a contemporary phenomenon in a real life context when the boundaries between the phenomenon and the contexts are not clear' (Yin, 2009: 13). Online Farm Trials is a single case study. When the same techniques and approaches are tested across multiple case studies then there is an enhanced capacity to build a stronger evidence base based on multiple point testing of the same questions and points of interest. For CeRDI, which designs and delivers a range of technological innovations and makes these available as online open data, the phenomena being examined are the information, knowledge building and resource sharing impacts of the portals that are developed and operationalised through the Centre.

Within the context of the MBSD, the research focus is on measuring the capacity of open data to achieve sustained practice change and build empowerment and ownership across groups, communities and industries

through technological innovation. This will be tested across six projects, of which OFT is one. The six projects that have been included in the CeRDI MBSD are:

- Online Farm Trials;
- Historic Urban Landscapes;
- Natural Resource Management Planning Portal;
- Visualising Victoria's Groundwater;
- Fire Hazards and Emergency Management; and
- Waterwatch and EstuaryWatch.

These six research innovations will each be examined as a single case study within an overarching multiple case study research project, which will allow for comparative analysis of emergent impacts and trends that are specific to open access overall and validated across six distinct studies.

The use of a multi-site bounded system design increases the capacity for external generalisability of results (due to a deceased likelihood of findings being assessed as unique to a single case) and provides for greater analytical benefits from replicable and/or comparative findings (Yin, 2003: 54). The strength of this approach lies in the fact that it enables critical analysis of what is happening, and why it is happening – thereby strengthening the capacity to track trends and patterns. These insights mean that approaches can be altered or consolidated across a broad range of bounded systems, dependent on identified critical success factors for innovation (Corcoran et al., 2004).

This capacity for replication and validation of findings across multiple bounded systems helps to address perceptions and resultant criticisms, of social research as having low levels of research rigour. Overtly addressing potential criticisms can also occur through the embedding of a procedural approach that is applied systematically across bounded systems (Stewart, 2012). The development and application of selection criteria ensures that decisions to include or exclude a system from the research process are determined by a fixed framework. This maximises the capacity for comparability across bounded systems and minimises the potential for error in data analysis.

To ensure uniformity in what is being measured, there are five overarching research questions that will be applied across each of the six MBSD projects. They explore: (1) effective strategies for implementation of technological innovation; (2) processes for maximising stakeholder input; (3) impacts of the technological innovation; (4) processes for building evidence based knowledge repositories; and (5) the links between open data access and informed decision making for practice change.

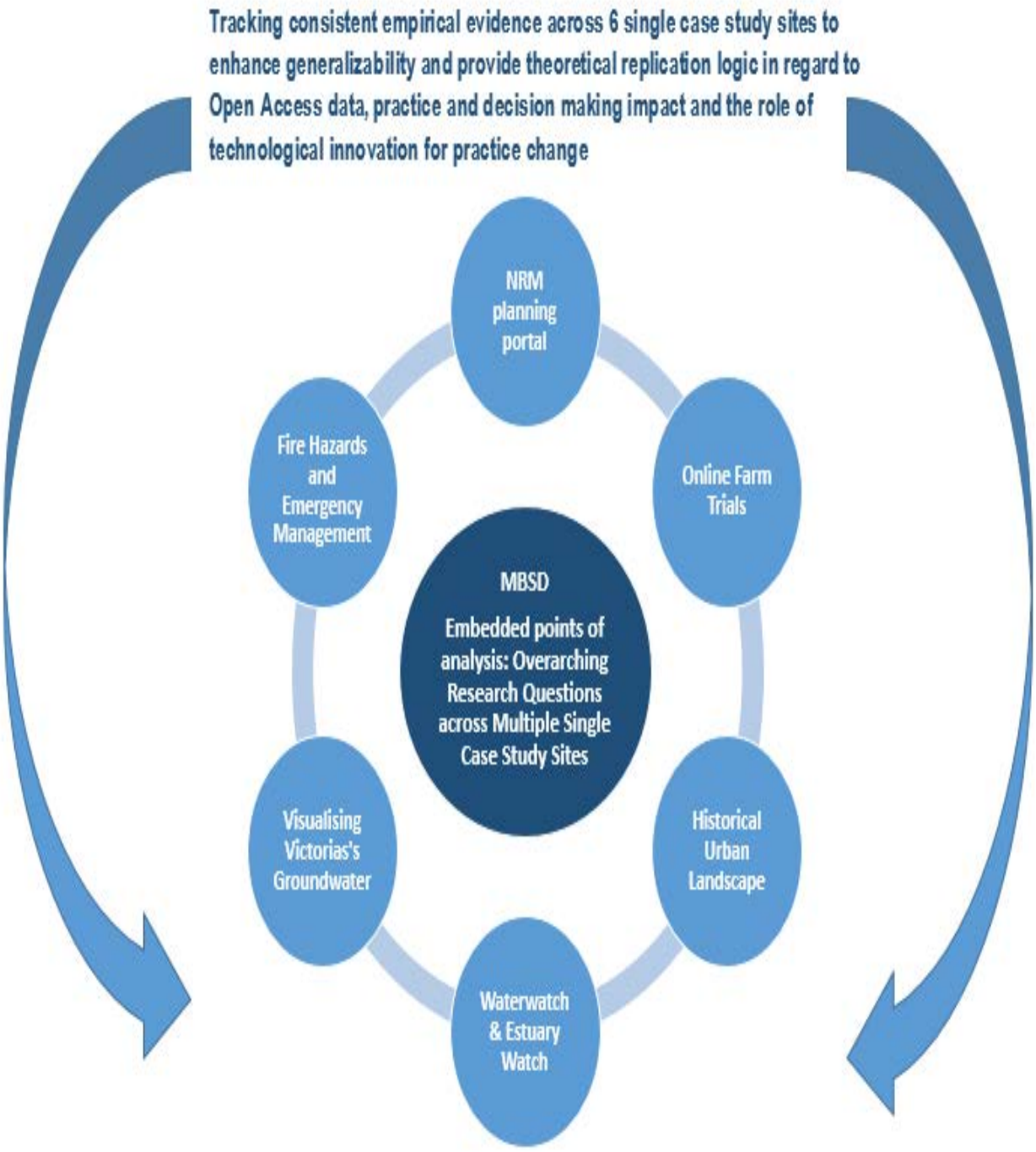
The specific details about the MBSD, including the research questions and selection criteria for inclusion as part of the MBSD are available in the 2016 CeRDI Research Directions Paper (available through contacting CeRDI at aa.murphy@federation.edu.au).

Despite the fact that the MBSD aims for replication of the study across a range of sites, it is acknowledged that contextual and location conditions are likely to lead to variability in some elements of data collection at the different sites and across the different data collection points. Therefore it cannot be argued that the MBSD will apply a literal replication logic. Rather, it will provide a theoretical replication logic (Yin, 2003, p. 47) as it will seek to replicate and validate findings across multiple case sites, but will acknowledge that, unlike a strongly controlled and managed research environment, there will be capacity to accommodate site differences.

Overall, the application of this methodology will strengthen the validity of study findings – a particularly important issue for interpretivist study within a field that has traditionally adopted positivist research approaches. The methodology maximises the capacity for comparison, the identification of location or innovation specific factors and minimises the potential for researcher or location bias.

The links across the six single case studies within the context of the overall MBSD are presented in Figure 5.

Figure 5: OFT within the context of the multiple bounded system design



Section 4. Research study findings

4.1 Responding to an identified need

The establishment of the OFT project was designed as a mechanism for advancement in knowledge management and transfer that had previously been identified as a sector requirement independent of any study around the potential impact of this type of resource. Discussions with those involved in the development and implementation of OFT indicated that this resource was one that was needed to enhance stakeholder capacity to improve their potential for informed decision making. Although this background information was available prior to the commencement of data collection, it was not considered to be an independent assessment of the need for an online resource. This is because the narrative around the need for OFT had been drawn from those closely involved in the development and implementation of OFT. This was viewed, by researchers, as having an unacceptably high potential for stakeholder bias, and had therefore been excluded.

However, during data collection, independently-offered feedback noted the need for a resource such as OFT. Data collected during interviews included independent assessments that OFT was a resource that had been needed within the sector for many years, and that this was a key driver in seeking some type of resource through which to address this need. This type of feedback, although valuable in building the narrative about the role of OFT in the grains industry, cannot be viewed as an assessment of the use of OFT as a tool for change. This is because it was put forward as a general comment on the needs of the sector, and it was not linked to the specific questions about knowledge, behaviour and attitude. Acknowledging the generality of research participant comments on a historical need for a resource such as OFT, there is value in commencing the results section of this report with participant feedback that reinforces that OFT was not an innovation that had emerged independently to sector priorities. Rather, research participant feedback supported the view that there was the need for a readily accessible online tool that facilitated the consolidation of large amounts of trial data. It also reinforced the argument that a lack of consolidation and easy access to farm trials data had been identified as an information shortfall across the sector prior to the development and implementation of OFT.

A total of 20 out of the 37 interview participants (just over 54% of the interview pool) indicated that some type of online resource through which to readily access trials data was a long standing need across the grains industry.

This assessment was captured in the following representative statements from research participants from across the different groups involved in the interview component of the data collection process:

> *"There have be farmers who, since GRDC's inception in 1990, have really wanted access to, I guess a co-ordinated and facilitated trial system" [Interview participant: GRDC staff member].*
>
> *"It is a great way to capture information and the critical need for access – it was so needed [within this sector] and it is conceptually a great way to go forward; such a great way" [Interview participant: GRDC panel member].*
>
> *"OFT is much needed and is responding to a need that has been there for a very long time" [Interview participant: grower group].*
>
> *"It will be such a great way to get questions to the answers that we have and have had for a long time but had no easy way to get to it. This is something we really needed and I can't wait to start using in for my own needs" [Interview participant: grower].*

This feedback provides a valuable starting point against which to consider the data that is analysed and presented in the following sub-sections of this report.

4.2 Examining the 'readily measurables' and what they tell us about OFT

In commencing an examination of the impact of OFT, it is important to give detailed consideration to factors that are often considered 'readily measurable' such as access levels, perceptions around ease of navigation, assessment of quality of visuals and trends in usage. This type of information will provide a valuable reference point against which to consider information relevant to behaviour changes and shifts in attitudes.

However, before moving into a specific discussion of the feedback provided relating to OFT, it is important to gain an understanding of the number and types of participants involved in the data collection process for this study.

4.2.1 The research study participant pool

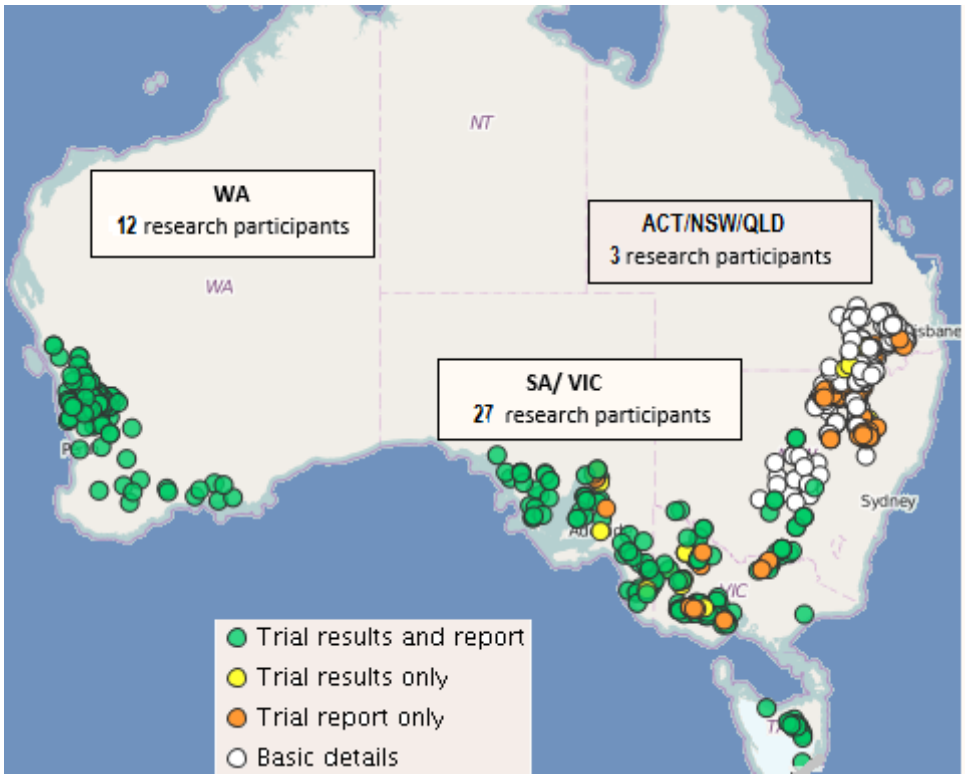
There was a total of 37 participants involved in the interview component of data collection, with the overall breakdown of data collected and analysed across each of the data collection techniques for this current wave of data collection (Wave 1) outlined in Table 1:

Table 1: Participation levels across data collection types (Wave 1)

Data collection methods	Data collection Period	Profile of data accessed/ participant type	Numbers
Document analysis	2013–2015	All documents relevant to OFT (promotional and marketing, web site; funding applications; external documentation and agreements re OFT) were reviewed using qualitative document content analysis techniques	N/A
Individual interviews	June 2015 to February 2016	● Growers groups ●Agricultural Consultants ● Industry Representatives ● Panel members ●Funding body representatives ● Researchers● Growers.	37 Participants
Online survey	July 2015 to November 2015	Site users, including, but not limited to: ● Growers groups ●Agricultural Consultants ● Industry Representatives ● Panel members ●Funding body representatives ● Researchers● Growers.	Participants from a Victorian grower group.
Email feedback	2013–2016	● Growers groups ●Agricultural Consultants ● Industry Representatives ● Panel members ●Funding body representatives ● Researchers● Growers.	89 participants
Google Analytics	July 2013–January 2016	This involved the tracking of service usage data for users who have accessed the OFT web portal from project commencement until the end of the data collection period in January 2016.	N/A
TOTAL PARTICIPANTS			131

The specific breakdown of the number of participants across both the interview and survey components of Wave 1 Research, across the different states in Australia, provides some valuable initial insights. The option for involvement was provided equally to all states, but involvement rates varied across states. There were 12 participants from WA, three from the NSW, ACT and Qld cluster, and 27 from the VIC and SA cluster[1]. When these participation rates are overlayed with data on the number of trials uploaded onto OFT, there is a correlation between level of research participation and number of instances of full data upload (when both trial results and trial reports are available for access through OFT). In both WA and VIC/SA, where there are the highest number of research participants, there is also a high number of trial reports and trial results that have been published. In the NSW/ACT/Qld cluster, the number of research participants is low, as are the number of full reports and full trial results. This is depicted visually in Figure 6.

Figure 6: Research participants across Australian states



This result is most likely to be a reflection of the point-of-development of the OFT roll out in each of the locations rather than a trend of resistance to OFT. It should be noted that both the WA and SA/VIC clusters have, since project establishment, been provided with additional implementation support. For WA, this support has taken the form of a part-time OFT project officer, who is based in WA. In VIC/SA there are strong industry ties, with Victoria being the state where the majority of the OFT team is based. Victorian industry ties include with the Victorian Grower Group Alliance (VGGA), with Southern Farming Systems (SFS, with whom OFT undertakes a range of projects) and with local agricultural consultants who have acted as experts in agronomy for OFT.

[1] States and Territories have been clustered together because two of the grower groups involved in the research delivered services across more than one state. Additionally, one participant was from the ACT and so was also included in the NSW/QLD cluster for convenience.

The link between level of support given and the rate of uptake of OFT has not been specifically tested in this research study, although it is noted that in regions in which support levels are higher (whether through the funding of staff or as a result of industry partnerships) there has been a higher level of information publication on OFT. Given that each of these three states (or cluster of states) were part of the pilot study, these differences in both research participation and in input of OFT trial data signal the need for some additional engagement and support work to be undertaken by CeRDI with Qld and NSW as part of ongoing OFT implementation. This is an issue that will be addressed through the recommendations of this report, with changes tracked for review in Wave 2 research for OFT.

In summary of this sub-section, the number of participants and the diversity in the groups from which they were drawn, provides a solid pool of baseline data for Wave 1 Research. This is particularly true when the data collected from research participants is triangulated against data from other methods used in the data collection process (such as emails and program documentation).

Given this body of data from which to draw insights, the first issue to be examined relates to usage levels of OFT and, linked to this, end user assessment of OFT.

4.2.2 Usage – only a small indicator of potential

An analysis of levels of use of OFT since establishment indicates that, at this point of implementation, levels of usage of the resource remain low. Although this is noted, these low levels of usage cannot be considered an indicator of lack of success of OFT to reach the target audience. This is because there are a number of mitigating factors that need to be taken into consideration.

Since commencement of the project, a significant proportion of time and effort has been spent on working with grower groups to get farm trial information organised, imported, uploaded and published at each of the participating sites. As identified in a previous section of this report, during the first year of establishment of OFT, the site carried trial data from only three grower groups. This was because these three groups constituted the pilot element of the innovation. This was a planned and legitimate strategy, although the small number of groups involved during the pilot immediately impacted on usage rates for two reasons. Firstly, initial awareness of OFT was limited to these three groups. Some marketing and development work was undertaken during the pilot stage of implementation, the main focusses were on data input, addressing early point-of-development issues, supporting pilot groups in their roll out, and working to identify areas and groups to be targeted for possible project expansion. These were all critical tasks and foundational to the ongoing success and sustainability of OFT, but the initial focus did invariably impact on initial usage levels of OFT. The second reason for low usage levels is that the limited and location-specific farm trials data on OFT did not act as an incentive for access by other individuals, groups and organisations at the national level. Available literature has highlighted the importance of both regionally-specific information and/or of comparable information from which data can be drawn to strengthen and inform local knowledge and regionally specific decisions (Easdown and Starasts, 2004; Llewellyn, 2007; Reardon-Smith et al., 2015; Vanclay, 2004). Thus, with only three pilot groups in place at the start of OFT, comparability of data sets was nowhere close to optimum levels, and this has impacted access and usage rates to date.

The expansion of the site to include a greater number of farm trials from a larger and more diverse number of locations has occurred gradually but consistently. As at February 2016 there are farm trial data in place and accessible from 13 grower groups/organisations, with this number increasing regularly as additional data sets are published. There are currently an additional 10 data sets that are in the process of being completed and published, and will be made accessible in coming weeks and months. This number will continue to increase into the future as more organisations and grower groups become part of the program.

Consequently, the use of the existing data on level of access and on usage rates provide valuable baseline data but cannot, at this point, be considered to be an accurate reflection of the success (or lack thereof) of the OFT

project. Level of access and rates of usage become reliable measures once the innovation is at an optimum point of development and delivery. As research occurred at a time when OFT was still at a developmental stage, the context needs to be considered as part of usage assessment. There is further work to be completed in relation to marketing to increase the number of data sets and in the achievement of participant group longevity (i.e. this occurs when farm trials information from individual grower groups has existed on the OFT site long enough for key stakeholders associated with that group to be aware of the resource, and the inclusion of their data within it).

Acknowledging these qualifications on usage as a definitive measure of uptake at this point of OFT development, a consideration of trending data on levels of access and of usage remains a valuable exercise in knowledge building.

A review of Goggle Analytics shows that, in total, there have been 3765 users (over 9253 sessions) since establishment of OFT in June 2013 (a total of 936 days to 21 February, 2016)[2]. It is important to note, however, that the first year of operation (June 2013–June 2014) was a time of pilot group identification and liaison, entry of data sets and trialling of the innovation. Subsequent to this, no measurement of usage occurred for the first 357 days of operation. This means that the user and session data that are available are relevant for a period of 609 days rather than the total of 966 that have expired since establishment. The specific breakdown of users and sessions, presented in 3 month clusters, and including percentage increases over time, is provided in Table 2.

Table 2: Number of users and sessions 30 June 2014 – 21 February 2016

Quarter	Number of sessions	Average sessions across quarter	Number of users	Average no. users across quarter	% Increase users from first quarter
June–August 2014	349	116	171	57	0%
September–November 2014	1302	434	475	158	+277%
December 2014–February 2015	965	322	601	200	+351%

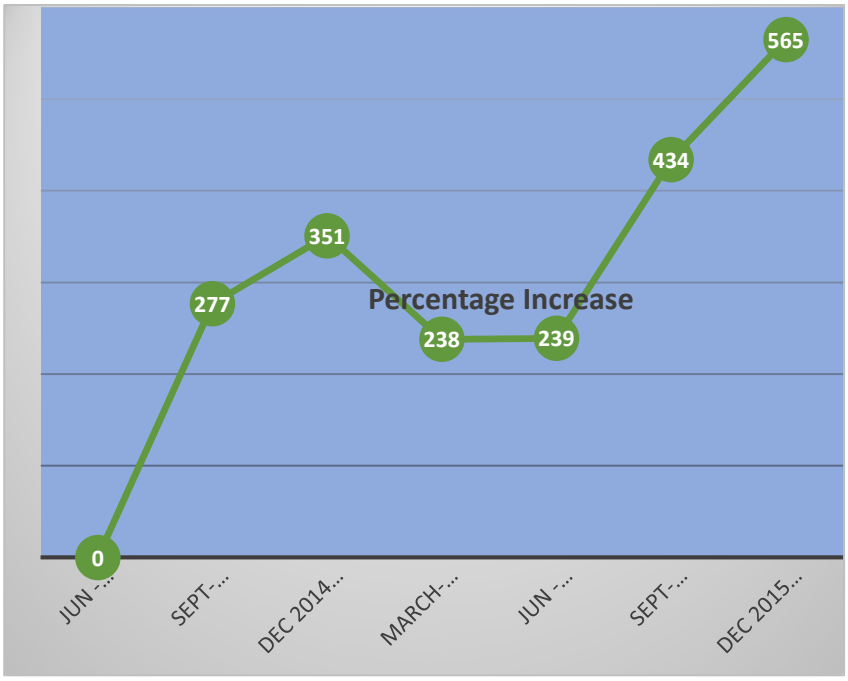
[2] In order to be accurate and transparent, it must be noted that in this establishment phase, data collected through Google Analytics have not been separated into internal and external end users. This means that the total figures provided (above) include CeRDI staff access. This involves staff undertaking site review work, checks for accuracy and responding to feedback for site changes. These are not legitimate access points for measurement of site usage for the purpose for which it was established. A realignment of current figures by CeRDI programming staff indicate that approximately 25% of the total figures for users and sessions relate to access by CeRDI staff for these type of reasons. Consequently, total figures cannot therefore be considered an accurate representation of access by independent end users: this is overtly acknowledged. The 25% has not been removed at this point for two reasons: (1) the use by CeRDI staff varied across the data collection timeframe, with the average across total figures being 25%. However, accurate realignment on a month by month basis was not possible without statistical inaccuracy so the decision was made to work with total numbers; and (2) some component of the CeRDI staff access was representative of legitimate OFT usage points as internal staff used the system to research a particular issue and/or provide data to support and inform decision making. Removal of these accesses would have been incorrect. Given that the figures for access at this point of the roll out of OFT are small, and the aim at this time is on trend identification over raw numbers, the decision was made that internal access numbers would not be removed from the overall total. Rather the situation would be bought to the attention of the reader to ensure transparency. From February 2016 onward, figures for internal CeRDI access have been be removed through use of a filtering mechanism (non-retrospective) therefore this issue will not occur in the next waves of data collection.

Quarter	Number of sessions	Average sessions across quarter	Number of users	Average no. users across quarter	% Increase users from first quarter
March–May 2015	1029	343	401	134	+238%
June–August 2015	1595	532	408	136	+239%
September–November 2015	2058	686	742	247	+434%
December 2015–21 February 2016	1955	652	967	322	+565%
TOTAL	9253		3765		

As identified in Table 2, the percentage increase over time provides some good indicators for OFT. Although the overall numbers are small, these figures show a clear upward trend in the use of OFT over time. The upward trend has been consistent, with some variability, over the 18 month timeframe. There was a dip between March and August 2015, when compared to the figure for December 2014 to February 2015 (+351%), at no point did the figure go into a downward trend. Additionally, it is important to note that as the resource is likely to be used more consistently in the pre- and post-growing season, the dips that have been identified are not unexpected, and are potentially indicative of natural seasonal demand curves (although this will need to be tracked over a longer timeframe to be claimed as a definitive trend or due to seasonality).

Overall, across the data collection period, there was a 565% increase in the number of users, in comparison to the 3 month cluster measured between June and August 2014 (the starting cluster for measurement of usage rates). This represent a positive and unbroken growth curve since establishment – an upward trend of usage depicted clearly in Figure 7.

Figure 7: Percentage increase from initial 3 month cluster: July 2014 to February 2016



This upward trend provides an initial indicator of the growing strength of OFT as a resource in the grains industry and it is unquestioningly a positive trend. However, it is a trend that will need to be sustained and strengthened into the following waves of research for OFT before it can definitively be assessed as a positive impact measure. This is particularly true given the small number of participants tracked over the data collection period. The trend identified in the usage analytics is further validated through the survey process. The number of responses from the survey process is acknowledged as being low[3].

Of the five respondents in total from one Victorian grower group – only three of these had, at the time of completing data collection for this for this wave of research, used OFT in their work. Two out of these three respondents indicated that they used the portal between 1 and 5 times, whereas one indicated that they had used the site between 6 and 15 times. Importantly, this respondent indicated that, once they were aware of the resource, they had begun to access it regularly to inform their understanding and knowledge about different issues, accessing the site on a monthly basis.

The issue of repeat access and use of a technological innovation are important indicators in relation to sustainability, a factor that has been recognised consistently in the research literature. In the measurement of effectiveness of technological innovation, significant work has been undertaking on the issue of engagement and participation with technology, including ladders of e-participation – capturing the different stages of connection with technology (Freeman & Quirk, 2013; MacIntosh, 2004; 2009; Mulder & Hartog, 2013; Norris, 2010).

These works have shown that, for sustainability into the longer term, it is critical to move participation levels with innovation away from single visits (which often occur just to see what the innovation is like and to see what it can do) and toward the building of ongoing engagement in which the resource is being considered as part of the suite of supports used to inform decision making.

Although an increase in new users is a target sought by any technological innovation, the overall aim for a portal such as OFT must be to ensure that the proportional breakdown of return users is, at least equal to and preferably higher than that for new users. This is because although having a high proportion of new users may mean that the resource is gaining greater levels of awareness and interest across the sector, if this is the consistent trend, and one not accompanied by a concurrent growth in return visits, it also means that potential for sustainability is weakened. Available data through Google Analytics indicates that, averaged across the data collection period of

[3] Please note that the survey has now become part of the OFT site and it is anticipated that a larger number of survey responses will be able to be accessed for wave 2 research

23 June 2014 to 21 February 2016, the new user to return user ratio for OFT was 33% (New) and 67% (Return)[4]. Although this figure must be used with caution, it indicates a good proportional trend. This is supported by feedback from survey participants who indicated that they returned to the site once they were able to begin to use the resource as a mechanism to enhance their work practices. Interview feedback from participants in this same grower group also supports this assessment with statements such as:

> *"Well there's a massive amount of work that has been done and it was all just lying in results books for grower groups anyway. I spent hours trying to compare different information from the hard copy version and then I realised that I could just access the specific information really easily through the search function. Ever since then I just go back and use it to make my job a bit easier. We are a bit time poor and this is great shortcut. It's handy if you are starting a new project or wanting data about a particular topic it saves flicking through you know 10 results books and finding individual reports. You can just say everything that's related to nitrogen and you get across years and across grower groups if you want. I guess that's what I've found if helpful for, getting a bigger picture of the data that's available and I think if you were to use it in that sense at the start of the project it might help you inform your decision making, if there is a report that it brings up that is exactly what you were thinking of doing" [Interview participant: Grower group].*

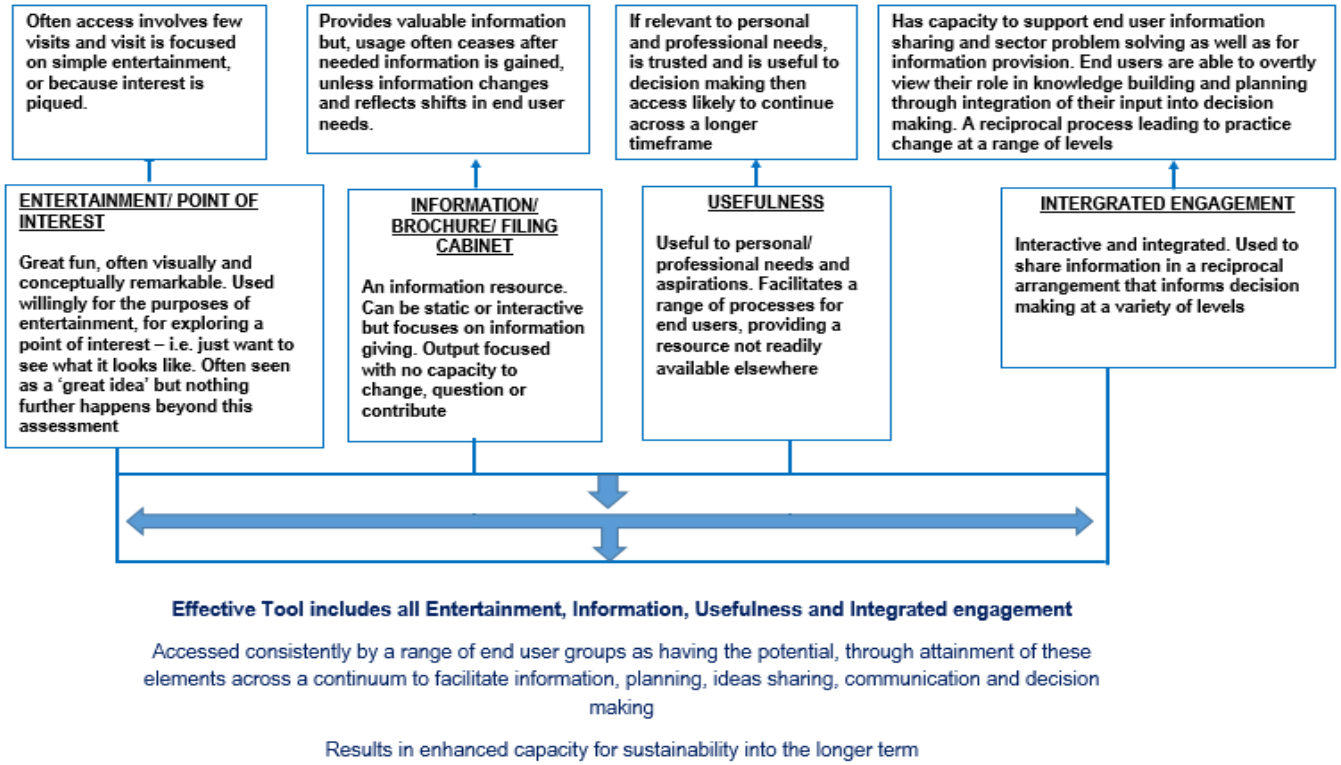
Conversely, although this feedback from grower groups is encouraging, a significant proportion of those involved in the interview component of data collection, particularly those not directly involved in the provision of grower group data, identified that they had made few, if any, return visits to OFT. The low return rate was not caused by dissatisfaction with OFT, or because the information contained within it was not considered valuable for meeting sector needs, but it does highlight the importance of ensuring ongoing engagement with OFT across all target audiences into the future. Participation and engagement with a technological innovation can occur at one of four points along a continuum. The first point is engagement with the site for entertainment and/or because interest has been piqued. The second point is when the portal is used like an information brochure or a filing cabinet. The third means that the innovation is beginning to shift to informing decision making through the provision of insights not readily available using another resource. The fourth and final point is where the end user is so engaged with the resource that they integrate it in a number of ways in their problem solving and knowledge building processes. The movement across the continuum from interest to integrated engagement is one measure in achieving a sector wide impact (as discussed in the impact typology outlined in Section 3.2.4 of this report). This continuum of participation and connection with innovation is depicted in Figure 8.

In terms of where OFT sits on the continuum, there is an upward trend in usage and the emerging data (from Google Analytics) suggests that users are returning more than once to OFT: these are positive outcomes, but more work needs to be undertaken to ensure that a broader range of potential end users are engaged with OFT. It is in the recurring usage and uptake across a larger participant pool that the potential for OFT to move toward integrated engagement will be achieved. This is particularly relevant when interview data is considered. At this point of data collection for Wave 1 Research, there were a number of participants who were articulating the fact that OFT was a great resource – but one that you would only go to for information and when you wanted very specific feedback on an issue rather as an integrated part of individual decision-making process.

[4] This is a statistic that needs to be considered with caution as users may be doubled as both new and returning visitors within a given date range. If a new visitor came during this time period and returned during this same time period, they would be counted twice (within a given date range, both as a new visitor and a returning visitor). Returning visitors may also be "unique" within a given date-range. For example, if visitor X came before the given date range, but then later returned within the given date range, they would be counted as a returning visitor but that first visit would not be counted as a new visitor within the specified date-range. Conversely, if visitor X returned three times within a date-range they would be counted once as a new visitors (if it was their first time), once as a returning visitor, but that third visit, they already have been counted as a returning visitor, so although the sessions would increase, the returning visitor metric would not increment

"(it's a great resource but only…) Very periodic use – when people do a review. Information brochure type site. You would only go there with a targeted need" [Interview participant: GRDC panel].

Figure 8: Moving from Interest to integrated engagement: a continuum



Acknowledging the need for further work to be undertaken in increasing usage levels across stakeholder groups, there are a range of other factors that need to be considered in order to build a clear picture of the potential of OFT to achieve the purposes for which it was established.

4.2.3 The value of OFT in the grains industry

One theme that was explored during the interview process was the value that was attributed to OFT as a resource with the capacity to add value to the building of information availability and knowledge transfer.

Of those interviewed for this first wave of research, 100% assessed that conceptually OFT was both a valuable and a resource needed to enhance the potential for more informed decision making by key stakeholders. This level of consensus on a single issue is significant in the qualitative research environment as the complexity of individual experience and differences in individual perceptions of issues generally results in diversity on how each topic is assessed by different stakeholders. Although there was diversity in the number and range of issues raised by interview participants relating to OFT and changes that needed to occur to maximise project sustainability and enhancement into the longer term, it is notable that all participants in all interviews identified OFT as a valuable resource that has the potential to provide a range of stakeholders with access to information in a way that was not possible in the past. These views are captured in statements such as:

"This is the very valuable for decision making as it would help you to make informed decisions based on what has been done before. Would be an amazing decision making support tool. You will act on what you find" [Interview participant – grower].

"This project is really a ground breaking project for GRDC… at the tool it really has come together in terms of facilitating information exchange with our partners, in the first instance being grower groups" [Interview participant – GRDC staff].

"It is something that I would really like to see in place. We have been pretty desperate to be able to access information in a way that will help us to make decisions. It can be very frustrating because you don't know where to go to ask the questions and find the information in a way that is simple and visual and quick" [Interview participant – grower].

"We have a lot of people that at the end of the year read our trials manual from back to front. But some people get their agronomist to read it back to front, and then rely on their agronomist, and their agronomist should know it all. But, so in that case, this tool might be fantastic for that sector, and that information then get distributed to growers in that way. So I think that's a big part of where Australian agriculture is going, farmers don't, or they're perceived to not have the time to actually research these things now" [Interview participant: grower group].

"A very needed and valuable resource" [Interview participant – GRDC panel member].

When the starting point for review of an innovation is that it represents a valuable and needed addition to the sector, then the movement toward maximising the capacity of the resource to achieve the objectives for which it was established occurs within a framework of positive change. This is, in itself, a notable point of attainment. This is particularly true when there is a good relationship in place between those who design and operate the technological innovation and those who are the end users of this innovation. Literature on the issue has identified consistently the importance of the researcher/developer and end user relationship at a range of levels (Black, 2000; Blackstock et al., 2010; Reardon-Smith et al., 2015; Vanclay, 2004).

The fostering of an enhanced researcher and developer/end user relationship is one of the key characteristics of OFT. The planning, establishment and roll out of the resource have been characterised by high levels of consultation with members of the grain industry, input from grower groups and expert agronomists and a focus on the use of locally developed and managed data. Locally developed trial data that are held by local groups as data custodians is the central component and defining feature of the OFT resource.

This approach maximises end user control, emphasises the value placed on highly localised agronomic information and, through this, has created an effective mechanism for ongoing engagement – an approach closely following the with engagement strategies outlined in the literature (Busch, 2011; Cegarra-Navarro, 2014; Easdown & Starasts, 2004; Llewellyn, 2007; Lloyd-Smith, 2009; Nain et al., 2012; Robertson et al., 2009; Simpson et al., 2003).

The extent to which this approach enhances the value placed on OFT by end users is captured in statements such as:

"One of the key things about this product is that it is being driven from the ground up, so from that point of view rather than an IT solution that's developed by developers we've actually really involved key, key personnel that actually service the industry and sort their opinions on what features they like or dislike" [interview participant: GRDC staff]

Although the literature and the statement above focus on relationship building for knowledge transfer (i.e. – the data bases themselves), the focus given to relationship building in OFT has translated into higher levels of connection, facilitating the establishment of successful feedback processes. These support greater levels of achievement in building collaboration for addressing issues relating to the roll out of OFT, as shown by the fact that data collected through the email feedback system and through the interview process indicated that there are good feedback loops and positive relationships in place between CeRDI (and the OFT team) and a range of stakeholders.

4.2.4 Feedback loops building long term capacity

A starting point for examination of feedback processes and OFT is in the consideration of the email feedback that has been gathered from a pool of stakeholders[5]. This feedback provides researchers with information around the type of contact being made, and the reasons for this. These are detailed in Table 3.

Table 3: Email feedback to CeRDI

	August–December 2014	January–June 2015	July–December 2015	January–February 16	TOTAL
Queries about data (entry, suitability, formatting and operational)	2	28	25	2	58
Feedback on how to improve site	6	3	1	–	10
Site usage queries (one included feedback on how to improve site)	–	2	1	–	2
Positive response (including feedback on site improvement)	–	1	2	–	3
Positive response to CeRDI support on issues	–	1	4	–	5
Newsletter subscriptions	–	–	3	8	11
Total	8	35	36	10	89

Again, it is acknowledged that these numbers are small and cannot be considered a measure of any definitive trends. However, they do show that email traffic is not limited to data issues, and that positive feedback and suggestions for resource enhancement are beginning to filter into the feedback loop. The figures also show that there is an increasing interest in accessing information about OFT since implementation, mainly through the mechanism of the OFT newsletter. These findings mirror the findings of other case studies that are part of the multi bounded system design that was outlined in Section 3.3 of this report. The two case studies (Visualising Victoria's Groundwater (VVG) and Historic Urban Landscapes (HUL)) that have completed Wave 1 research also collected small clusters of data wherein there was an increase in positive feedback over time, as well as increases in the provision of suggested improvements to the system. Ongoing data collection for both VVG and HUL (which are moving toward and commencing Wave 2 research respectively) shows that, for those two case studies, these indicators have developed to a point of demonstrating definitive trends illustrating the critical role of strong feedback loops for adoption and sustainability.

The fact that a proportion of email feedback has moved away from requests for clarification on data specific points towards feedback and changes for OFT is a good starting point. When OFT interview feedback from those participants who have had the greatest level of contact with the researcher/development team since establishment is considered, some additional insights can be gained on the importance placed on feedback and connection by end users.

[5] The total email pool for OFT since establishment was extensive (thousands rather than hundreds). All emails that dealt with administrative issues, contracts, issues clarification and similar were removed from the overall pool as they had limited relevance to building a better understanding of the relationship between researchers/ designers and end users.

The relationship between CeRDI and grower groups, between CeRDI and some GRDC staff and between CeRDI and a small group of agricultural and sector consultants has been strongest during OFT implementation. These groups comprise a cohort of 72% of the overall pool of interview participants for this current study.

Feedback received through this cohort consistently identified that the feedback loops were strong and that the type of support provided played a key role in: (1) ensuring resolution of operational problems; (2) enhancing the potential for issues clarification; (3) the addressing of concerns; and (4) the building of an inclusive response strategy when moving toward successful implementation of OFT.

The following extracts from interviews provide insights into the views of stakeholders in terms of their relationships with the CeRDI OFT team:

> *"I think that [names given] have done a fantastic job, seriously to do what they've done in the timeframe they've done it in. Um, I think that, yeah it's, say it's a good professional job… It's the biggest thing, so nice to work with people who actually get it and ask questions and respond well and are really trying hard to get it right. Because I reckon it's a tough gig' [Interview participant: agricultural consultant].*
>
> *"…it just ran that smoothly, like it was perfect. Yeah really enjoyed seeing it all come together I guess without having to do too much at that point and being able to talk it through" [Interview participant: grower group].*
>
> *"Have navigated ... Feedback loop very strong. Makes it a lot easier" [Interview participant: grower group].*

Data analysed to this point of the report have shown that OFT, as a general concept, is considered an important addition to the grains sector of agriculture. The data have also provided insights into the relationship between the developers and end users and some insights into levels and type of usage.

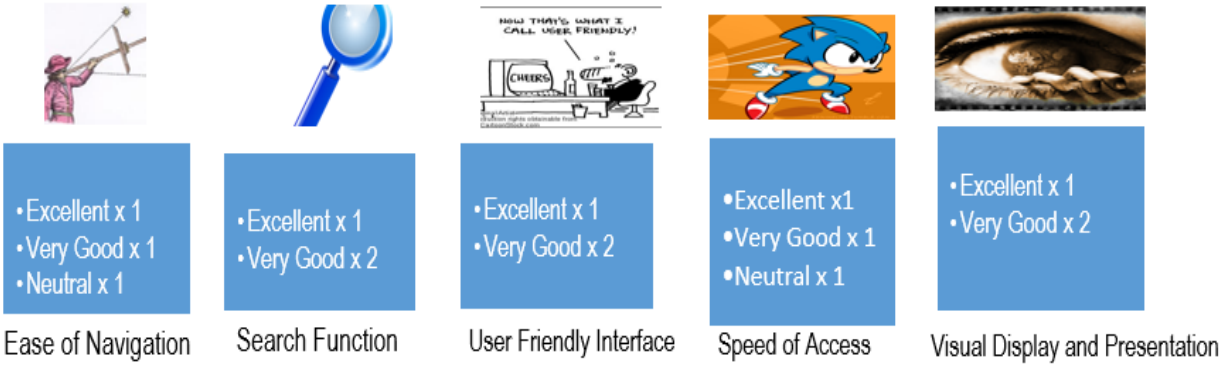
At this point it is also important to consider some foundational aspects of the OFT site itself, particularly issues of navigation, point of access and visuals to consider if there are practical issues specific to the technology itself that have been raised for discussion by research participants.

4.2.5 OFT Design and delivery strengths

Participants to both the interview and the survey components of the study were asked to identify the strengths of the technology itself and the areas within OFT that were most appropriate to meeting their needs. Specific feedback was sought in terms of the tools and attributes of OFT most valuable in facilitating the use of OFT and enhancing capacity to access information held within OFT.

A particular focus was given to understanding participant perceptions around the navigability of OFT, the ease of access (through the mechanism of the search function and through single point of access) and the visual appeal of OFT.

The three survey respondents who had been using OFT at the time of data collection recorded consistently high levels of satisfaction with many of the design features of OFT, rating them in the following ways:



This feedback shows that all survey respondents rated the search function, the user friendly interface and the visual display as either excellent or very good. In terms of access, two out of three rated the speed of access and ease of navigation as either excellent or very good, whereas one respondent for either variable was neutral in their assessment.

This feedback is mirrored in the qualitative feedback gathered at interview in which the a majority of 78% (29 out of the 37 participants) indicated that navigation, visual displays and the search function all worked well and were important success factors for OFT.

Those interview participants who did raise concerns did this in terms of the constraints created in certain locations as a result of poor internet access, lack of individual user skill in site navigation (which was related to an overall low skill level in the use of online technology rather than being site specific) or a lack of experience with the OFT site. These barriers align closely with issues that were raised in the literature as creating measurable barriers to the use of online technology, particularly at the individual grower level (Al Musawi, 2014; Anastasios et al., 2010; Easdown & Starasts, 2004; Rao Hill et al., 2011; Roberts et al., 2015).

One participant indicated that the site was no more or no less visually appealing than other sites whereas another indicated that more explanation of what each function could do was needed on the site. Only one participant stated that they found OFT difficult to navigate and 'clunky'. This participant was unable to articulate their reasons for this assessment.

Data analysis shows that access was, in the main, found to be facilitated by a range of factors. These were: (1) ease of navigation using the search function; (2) speed of access; (3) the user friendly interface; (4) the fact that it was a single point of access; and (5) the spatial aspects of the site.

The specific feedback that was given on the strengths of the OFT technology is captured in the following statements, which represent only a small proportion (20%) of the overall positive feedback provided across all interview data pertaining to the design and access features of OFT. The quotes provided are drawn from a cross-section of interview participants who commented on a range of design features.

> *"I have navigated the site and it works well – really easy to navigate and the visual are very useful… the search tool and the spatial entry point is easy and straight forward to use… Amazing to have a single point of access and such a great search function" [Interview participant: GRDC panel member].*

> *"The hard copy is set in stone, whereas an online tool is integrating, it's more fluid I guess, you can pull out the information that's relevant to you rather than having to wade through a whole report" [Interview participant: grower group].*

> *"We have really looked for a one stop shop where you can go and really easily get an answer to a question you might have – I am really excited about what I can do with this because it is simple, a single place to pull out information that is relevant and it is pretty fast (as long as the internet is working)" [Interview participant: grower].*

> *"The biggest one I think, the biggest value is the speed at which it can find stuff so from a consultants point of view if you need to research something or find out what happened in the past um, quick searches are really handy, I mean that's why people use Google and stuff like that because you just type something in and something pops up. I think it's that sort of immediacy of the information that I think where the value is" [Interview participant: GRDC staff].*

> *"OFT is great. Simple, intuitive, well set up – a really great resource for professional agronomists. The filters make it easy to access information and make it available. Visually great for capturing attention" [Interview participant: growers group].*

These assessments are indicative that OFT is meeting the requirements for ease of access and ease of searching, as well as navigability for the majority of end users involved in the interview and survey process.

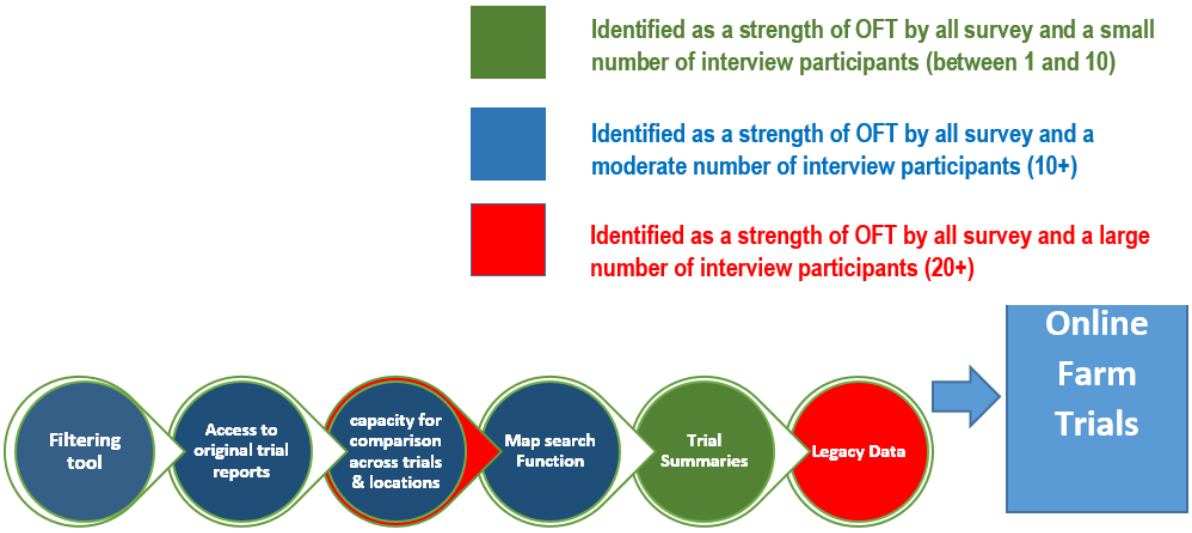
In addition to a strong trend tracking the ease of use of OFT, interview participants and survey respondents identified tools and content within OFT that were considered useful and valued for supporting informed decision making, albeit to different levels, dependent on the perspective of different participants.

These areas included the following points.

- The filtering tool: the ability to determine at the start of a search what years, locations and types of data the end user wished to include, and/or exclude, in their search, was identified as a valued function that increased the potential scope and focus of any search.
- Access to the original trial reports: this was viewed as an important transitioning element of OFT – enabling end users to refer back to original information to clarify points of interest, outstanding questions or cross reference information.
- The map search function: this was assessed as providing a visual aid that supported the search process, enabled a snap shot awareness of places trials had occurred and enhanced conceptualisation of locations, scope of trial activity and contexts.
- The trial summaries: these were valued because they enabled key information to be accessed easily and quickly without the need to go to the full report. They also ensured that key issues were able to be drawn from the data without difficulty and in a timely manner.
- Legacy data: the ability to examine historical trial data to clarify past findings, to understand what has been completed in terms of different types of trials and to build a better understanding of the scope of existing evidence was considered one of the most valuable elements of OFT. This issue will be discussed in greater detail in Section 4.3 of this report.
- The capacity for comparison across trials and across locations: although this was not a function that had been used extensively at the time of data collection, it was considered, as with legacy data, to have significant capacity for sector enhancement. The value of this design feature was found in the view that this could provide a mechanism to break down existing industry, location and knowledge silos and build a platform for collaboration. This issue will be discussed in greater detail in Section 4.3 of this report.

The fact that these elements were raised by both survey respondents and interview participants on a number of occasions, within and across interviews, highlights the value placed on them by end users. Figure 9 provides a snapshot of the extent to which these issues were the focus of OFT value identification for research participants.

Figure 9: OFT elements assessed as useful by survey respondents and interview participants



Other components of OFT that were raised as valued by EITHER survey or interview participants were:

- the capacity to export data;
- feature bookmarks;
- feature farm trial;
- soil information and classification;
- climate data; and
- treatment details.

Although each of these were identified as of interest to, and of value by different research participants, this did not occur consistently across data collection techniques. These findings are noted as part of the collection of baseline data for Wave 1 research and the value placed on these features will be reviewed and tracked in subsequent waves of data collection in order to determine the most valued elements of OFT over a longer timeframe.

One other issue that was raised during interviews related to the capacity of OFT to be accessed readily using mobile devices. This was considered to be a critical design feature, particularly for growers who are increasingly using mobile devices to access services to optimise the benefit of the time when they are operating machinery such as tractors. Effective OFT mobility means that these potential end users are able to access technology at the same time as they are undertaking farm work.

> *"The biggest issue for me is mobility, a lot of farmers are now using iPads and iPhones for their day to day operations, they're spending more time out in the paddock, um, probably our market research is showing that they are spending less time sitting in front of a computer and when they do, they only do it for specific*

purposes, like banking or checking the weather. They're not necessarily doing a lot of research from what I can understand. So, from a farm perspective we need to make the Online Farm Trials product mobile friendly so that it's not only proactively encouraging people on specific outcomes but it's also something that they can use when they're in a position to do it safely obviously" [Interview participant: GRDC staff].

"Got to be (able to be used) quickly, to be able to be absorbed quickly too, because while you are sitting on a tractor, and you still do have to be keeping some eye on the gauges, or the implement that's behind you, or the tree, or the power pole" [Interview participant: grower group].

The need for effective mobility has been recognised by the OFT team and was a key driver for responsive design work that was undertaken in 2015 for the purpose of achieving improved functionality, specifically for mobile technology such as iPhone and iPad. In this process, a particular focus was given to the use of a framework that would be responsive and adaptable to both desktop and mobile devices. Work was also undertaken on improving touch-screen navigation. As a result of this work OFT has become more mobile compatible, making mobility a priority development to meet the specific needs and workplace context of the agricultural sector. While this action has been taken it is also acknowledged that the large amounts of data contained on OFT (including graphics and mapping) has implications for mobile access. This is particularly problematic in areas in which connectivity is not at optimum levels; an ongoing issue in more isolated areas. This type of barrier to uptake was identified within the literature (Al Musawi, 2014; Easdown & Starasts, 2004; Roberts et al., 2015) and reinforced as an implementation issue in interview feedback.

"And we have another issue out here which is bandwidth and accessibility of downloading. So some, so maps and so forth take a long time to download, so it's just frustrating… (some growers) say at our house it could take five minutes to get a map to open. The majority of growers live outside of the, yeah, what do you call it, NBN now. So it is a challenge at the moment with that. Unless there is a tower that links from one tower, you need a tower nearly every 10 km, once the links broken it won't work" [Interview participant: Grower group].

Although there is little that can be done by the OFT team to address the infrastructure issues that create problems with connectivity (beyond raising the issue at government level), the need to optimise mobility will continue to remain a focus of OFT development into the future. This will occur in order to ensure design features and capabilities of the resource continue to be assessed as a strength of OFT.

The final issue to be explored in terms of 'readily measurable' relates to end user perceptions of the quality of the information contained in OFT.

4.2.6 Data quality and trust building – a complex jigsaw

Information was collected around the quality of the data contained on OFT as part of the research process and this was an area in which there was a level of divergence in perceptions amongst different research participants. It was noted that the divergence was closely aligned to the cluster (e.g. grower group, grower or panel member) from which the participant was drawn.

The 'high quality and high trust' pieces of the puzzle

In feedback from research participants who are members or employees of a grower group (i.e. grain growers) there was a consistent (although not unanimous) assessment made that the quality of the data was high and that data end users could have a high level of trust in the resource.

This was particularly true when the research participant was making reference to data that had been drawn from their own grower group. This was because the data was viewed as *'coming from reputable sources' [respondent:*

grower group staff] and participant trust in the data, and the associated assessment of quality, was closely linked to issues of confidence and control. Participants had been involved in the data building process and were able to make informed assessments in terms of quality. All of those who responded to the survey, and had used OFT, made the assessment that they had a high level of trust in the resource, and they felt confident that the quality of the data was high. They felt that the quality was appropriate to their needs in the areas of method/treatment, trial data, climate and resources through the report library. For these survey respondents, OFT provided good quality data across key areas of relevance to their practice and they could trust the information to support the process of decision making.

Further, 88% (21 participants) of participants from grower/grower groups who were involved in the interview process (total 24 participants) also made this assessment. These findings provided the researchers with insights into the power of the link that can be built when the research is locally based and locally relevant. End users were able to see an association between work they had been involved in (or that other local stakeholders had been involved in) and what was offered through OFT. As identified previously in the literature (Busch, 2011; Cegarra-Navarro, 2014; Easdown & Starasts, 2004; Llewellyn, 2007; Lloyd-Smith, 2009; Nain et al., 2012; Robertson et al., 2009; Simpson et al., 2003), the capacity for local relevancy, perceptions around the ownership of the data, and the recognition of this input, are critical factors in building engagement. This evidence reinforces and validates existing OFT team strategies for building confidence and trust in data quality and is a positive indicator for engagement and ongoing involvement with OFT.

OFT is valued because it can provide a mechanism to accommodate the call for both local (and trusted) data sets, and national data. The level of trust held at each local area is helpful in supporting uptake of OFT. The longer-term challenge is in building this trust to encompass data not developed locally.

> *"… from our point of view it's important that we get nationally uniform sets because it's a national project. That being said though um, it's a bit of a double edged sword because growers want more localised material. So they want, they want the best of both worlds, they want to be able to see what's going on in my district but they also want to be able to see what's happening right across the country" [Interview participant: GRDC staff].*

Ownership of localised agronomic data is recognised in the literature, and in research participant feedback, as an important determinant of building trust in the relevance and quality of information. Building trust in sharing locally developed data at the national level can be more difficult. The transition to making local information available to an external information sharing system is not as simple as trust in the data itself. The interview process identified the 'double edged' nature of data sharing and potential barriers that can arise – not only in terms of trust but also in terms of data ownership.

It is necessary to consider the issues of overt recognition of data ownership and fear of loss of control over data. Concerns were raised about these issues during the interview process and were identified by a small number of interview participants as resulting in their early stage resistance to engaging with OFT.

It is acknowledged that these issues were only raised by a minority (seven) of the interview participants (19% of the overall interview cohort); however, an exploration of the issue is valuable as it has some implications for ongoing engagement with OFT. There were a small number of participants from different grower groups who were supportive of the notion of OFT, and saw the potential of the resource, but struggled with: (1) sharing the information; (2) the additional workload of inputting information; and (3) grasping the full potential of making localised information available for national access. This was a transitional problem, but was identified as diminishing as grower group staff began to use the system – it is noteworthy as it illustrated an implementation dichotomy. On the one hand localised information is essential for engagement and for building trust and confidence in data quality. On the other hand the loss of control over the information management process can

create a level of resistance to uptake and distrust of the third party implementer who has facilitated broader sharing of local data (rather than trust in the data quality itself).

This is captured in the following statements from a grower group members:

> *"… just trying to get the staff on board to want to participate. It's been a bit, I suppose I've pushed them a bit to participate they haven't necessarily, they haven't seen the value of it straight away, all they've seen is it's extra work doing stuff they already do, where they lose control" [Interview participant: grower group].*

> *"… not sure what it looks like or how that's happening, just someone is funded to do it and it's duplicating everything we've already done once. And I was (at first) unclear how might help – it is the information we worked on and we can answer questions about and it is on our site so why put in on another – although I think we should share information so I guess if we can get answers to questions then it would be good and then you could compare so yep that would be good…umm……." [Interview participant: grower group].*

Linked to this issue is the retention of control over data into the longer term, and the overt acknowledge within information sharing systems such as OFT, of this ownership. As explained by a grower group member, maintenance of trust and ownership are inextricably tied together for local stakeholders as they build their ongoing involvement with OFT

> *"So this is I suppose where it comes back to the core OFT of how each Group's intellectual property is handled and how second and third parties can access this information is going to be I think fairly important about building trust around this space. It would be very easy to blow the trust and make people say I don't need this… But if we want growers to actually embrace this whole concept to get the whole value of data, and work out the value of them working with their neighbours and people, and likeminded farmers across Australia, then they need to have trust that the industry and that's grower groups, GRDC, universities, are thinking about the person who, the people who are creating that data first and foremost rather than as a secondary bystander who may or may not get some benefit from creating that intellectual property. Because in the end, that's even for the grower group, really that data from the trials is one of the few things that growers will value" [Interview participant: Grower group].*

The current structure of OFT facilitates retention of data ownership through consistent identification of grower groups within the site (e.g. within search and filtering tool, through overt attribution of data sets to the grower group, in full reports). Additionally, ensuring that all data drawn on by OFT remains with data custodians (i.e. the grower group themselves) decreases any capacity for data ownership to become lost/blurred over time. It is the clear philosophy of CeRDI, and the OFT team, that those who create the data sets are to retain control over them and that this ownership be overtly acknowledged. However, as the site grows, and reach and capabilities expand, the use of the data for a range of activities by a range of groups and individuals will correspondingly expand. As this occurs, the ongoing recognition of data ownership could be lost and the focus becomes more on OFT as the data source. There is no evidence at this point of development to suggest that this will occur; however, given that it was a concern raised, and that trust building and belief in the quality of the data is pivotal to success and sustainability of OFT, it is an issue that needs to be acknowledged as a conflict which, for some participants, is closely linked to trust and connection.

This relationship between data ownership and data sharing is a dichotomy that needs to be reflected upon by researchers so that transitional support to new groups, as they come online in coming months and years, as well as ongoing support to existing grower groups, accommodates these tensions as effectively as possible.

The 'low quality and low trust pieces' of the puzzle

At the other end of the continuum on quality and trust in the data were a small number of interview participants who were concerned about their ability to trust the quality of information drawn from the trials. There were six participants to the interview process who were supportive of the notion of OFT but who assessed that use of the

information in any decision making and knowledge building process was potentially problematic because there was no clear measure of scientific rigour. This group of participants were drawn from GRDC panels and GRDC staff and the concerns they raised related to the following issues.

- The lack of access to raw data. There were interview participants who felt that, for OFT to be effective as a knowledge building and decision making tool, there needed to be the capacity to access raw data in order to better understand the rationale for the assessments made, and to cross check for validity.

  These views are captured in statements such as

  > *"Unless there is the capacity to go back to the raw data then how do you check the scientific validity of what is being available. You need this to be sure in what you are deciding and whether what you are looking at in the summaries captures what the raw data found" [Interview participant: GRDC].*

  It should be noted that full trial reports are available through OFT – in the same way that they were available to growers prior to establishment of OFT. The scope of the information available is equal to what was available in the original hard copy report. The concern in this instance arises from the fact that the ability to cross reference and draw on greater amounts of data simultaneously increases the likelihood of conclusions being drawn from larger pools of data. These interview participants were concerned that not being able to access the raw data such as field notes would result in all uninformed rather than informed decision making. People would be making comparative analyses without any capacity to understand the comparability of information when trials differ in a range of ways across times and across locations (climate, soil, focus of trial, methods used, skill bases of researchers).

  Additionally, while not part of the interview or survey process, discussions have occurred between the OFT team and senior researchers around potential strategies for maximising data quality and usability for research and evidence building. These discussions align closely with the issues relating to lack of availability of raw data that were raised by research participants, and with suggestions made by interviewees. During these discussions, suggestions made included the implementation of pre- and post-data measuring techniques that could be part of the trial details on OFT. It was suggested that these pre- and post-data measuring techniques could occur across a range of key areas including the following.

  - Soil – soil quality variability across different trial sites can make it difficult to make valid comparisons if, for example, there are major differences in soil pH. Testing and recording variability in soil quality to ensure all valid data variables are available for inclusion in data comparison processes.

  - Growing conditions – the inclusion of growing condition data for an extended timeframe (beyond the current OFT standards of sowing and harvest date) as there are variables that impact between these dates and need to be captured as part of maximising data comparability accuracy.

  - Sowing method – the inclusion of this type of pre-trial data addresses variability resulting from factors such as depth, spacing and the degree to which soil was compacted, post sowing.

  This perceived lack of raw data was a key quality issue for this group of participants and one likely to impact on confidence levels for the use of OFT data for research.

- The lack of a clear and readily accessible measure of quality and evidence reliability. Two thirds of those in this small cluster of six participants identified that users needed to be able to determine the quality of information against a pre-determined hierarchy of evidence. A number of different

suggestions were made such as levels of dependability, comparison with peer-reviewed research or an identifier around the scientific rigour of a particular trial.

> *"I think that, before you can use the data from OFT to make decisions or include it in planning, you need to have some way of making a choice about what the evidence is. Some way to indicate clearly level of quality and how reliable it really is. Then you can use it or not use it or use it with conditions" [Interview participant: GRDC panel].*

There were also concerns raised that inclusion of trials without a clear and uniform quality rating that would result in individuals making assumptions that all trials were adopting standardised scientific approaches and techniques. The consequence of this would be that flawed assumptions around equal validity measures across different trial data would be made, as would assumptions around the comparability of that data. It is important to state that this was not given as a reason not to implement and support OFT. Rather, it was a quality assurance inclusion that was considered an important part of ongoing development ad enhancement of OFT by this group of participants.

The 'buyer beware' pieces of the puzzle

The final type of assessment that was made in terms of data quality was that the provision of data, in a way that has never been possible in the past, must remain the focus of OFT. This group assessed that too great a focus on quality and quality tracking has the capacity to diminish the overall benefit that can be gained from the resource.

Ten participants (27% of the overall cohort) identified that having access to previously inaccessible data through a single point of access was more important than restricting information for quality assurance purposes. There were a number of rationales given for this approach as detailed below.

- The focus on scientific literature and scientific language can be exclusionary. This view aligns closely with the literature on enhanced accessibility and usability and the need for plain language as part of inclusionary practices for the agricultural sector (Al Musawi, 2014; Van Meensel et al., 2012). Participants identified that there has not been an opportunity to access literature that was not considered to be of a rigorously scientific 'gold standard of evidence' in the past in a way that was so comprehensive. OFT was assessed as capturing critical information and making it available to the sector in a manner that has not been captured anywhere else. This was viewed as a major advantage and something that rigid adherence to quality structures and high levels of scientific evidence would negate/compromise.

  > *"I would have loved something like this at university, just trying to look up trials and that kind of thing because you don't want to read scientific papers half the time" [Interview participant: grower group].*

  > *"I don't think we can play down how valuable access to, let's call is 'grey literature' is. We have never had access to anything like this in the past and it is really something we need to get a mind shift around what data can do for some groups and areas and for understanding problems more" [interview participant: GRCD panel member].*

- Individuals have the capacity to differentiate good and bad data. Participants identified that individuals needed to access a range of data and that they themselves were able to make informed decision about the value of information if they are given the opportunity to access it, The provision of sufficient information to make comparative analyses and identify trends is part of the knowledge-building process and should not be censored to include only pre-determined elements.

  The science itself was acknowledged as being very important but access to a range of data types is a critical part of building the bigger puzzle

> *"I'd rather see all the data and make a decision of what bits I'll trust and won't…know they have kicked around for a while this idea of different star ratings or something, or quality ratings or something. Um, I'm not overly convinced that's the right way to do it, because even if you've got a bit of data that might be a little bit, um I hate to feel that something like high quality data has missed out getting a contact or getting a methodology within there or um, different things they've measured, I think gee I wouldn't have thought of measuring that but I can see how that's been useful, just because at the end of the day the CV on the yield or something was greater than 10% people say well that's a lesser quality trial because there's greater variability in it, there's lots of other stuff you could learn and as soon as you put a rating on it to say this is a lesser trial instinctively people just cut it out. So I'd rather be able to find it all, and then go through it and go oh that's a bit dodgy because that rainfall year or gee look at was sown in June, you know we don't sow in June here so I will exclude that data because it's probably not typical of what we find. You know, I'd rather be making those choices…, as soon as you start (rating) you'll get some peoples noses out of joint and they won't bother. So the groups that maybe don't have the same level of statistical ability to analyse something for example they may just be paired paddock results, like I'm happy to look at paired paddock results and know the limitations of those but if I had 20 paired paddock results from different areas and they all seemed to be showing the same trend, my confidence in that, in that gee there might actually be something here and it might be a better treatment than something else. And if they're all rated 1 star because they're not replicated or fully replicated, I'm missing out on that opportunity to see that stuff" [Interview participant: agricultural consultant].*

- OFT will only ever be one part of a larger whole. Interview participants identified that OFT will provide valuable insights but they are insights that will be balanced against other information on the area of interest. In addition to individuals having the capacity to differentiate quality issues (as outlined in the previous point) individuals also use multiple sources before making a final decision. Rather than increasing risk because quality levels may not be at the 'gold standard' this group of participants indicated that availability of the information enabled complex issues to be considered from an additional perspective and in a more informed way.

> *"[to suggest that] it will only ever be one source over many is bull… to think it will be a one stop shop is bull. I have no doubt that it will become an industry standard for how to make decisions but it will never be the only one" [Interview participant: GRDC panel member].*

A final comment on the issue of the quality jigsaw is best presented in the words of an interview participant who raised the question of quality within the context of data custodianship and OFT. They identified that the onus cannot be only on OFT to ensure data quality ratings. Rather, there needs to be an acknowledgement that maintaining local ownership and control, a critical part of building trust in, and sustainability for, OFT, also assumes that the data custodians will make measured decisions on what is included on OFT from their group/organisation.

Although the OFT team might work closely with grower groups to support the data entry and parameters for inclusion process, ultimately the decision for inclusion, and linked to this, quality measurement, rests with the data custodian.

> *"I think then you, you know there's got to be a standard that's agreed to for putting it on … (clarifying what you are) ah willing to accept as being of good enough quality. You know, so I think the onus on the quality side of has to be on the people loading it because it's got their name associated with it. And if they think it's a dodgy trial and they don't like it, don't put it on" [Interview participant: agricultural consultant].*

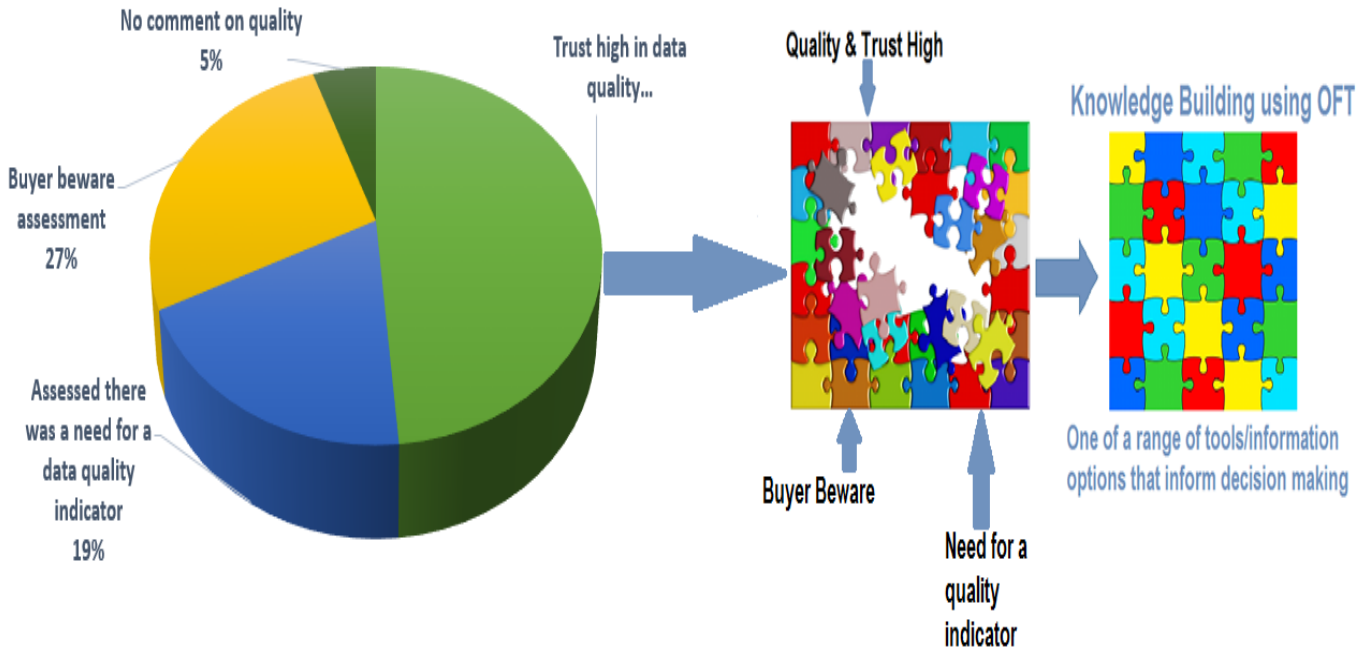
In summary, the process of exploring participant views on the place of quality management and quality assurance in the implementation of OFT identified that there is a disparity of views amongst different individuals and, oftentimes, but not universally, across stakeholder groups. Quality is viewed as part of a complex web. For some participants, the ability to use localised agronomic data sets increased trust in the resource, with data quality assumed because of their involvement in the building of the trial evidence. For others the lack of scientific rigour

and/or an overt system of identification of quality ratings was viewed as problematic for long term viability and sustainability. And clearly something that will need to be addressed into the medium to longer term through such measures as pre- and post-data collection techniques.

For yet another group, the concept of 'buyer beware' was the dominant view – the assumption that individuals have the capacity to filter good and bad data and take from available information that which is most relevant to meeting their needs. As the data will inform their own businesses they themselves will provide the filter for what is included and what is excluded. In this approach the buyer has the responsibility, and the ability, to be aware of the risk they take in using any single source of information over the use of a range of sources to make informed decisions.

The number of research participants from each of these groups, and the factors that have to be taken into consideration to complete the quality puzzle for OFT, as a technological innovation, is contained in Figure 10.

Figure 10: Quality and trust – a complex jigsaw



4.2.7 Findings summary: Examining the 'readily measurables' and what they tell us about OFT

Section 4.2 has examined a range of factors relating to end user perceptions of OFT, as well as data collected through Google Analytics, survey and interview on 'measurable' aspects of OFT. The key findings of this analysis detailed the following results.

- There was a consistent message from across the pool of research participants was that there has been a long standing need in the grain industry for an online resource that would be readily accessible, and that would establish a coordinated and easily navigated system for the body of farm trial data that exists in the grains sector. This assessment was not specific to OFT but rather an overarching assessment of a key identified requirement for achieving best outcomes in this agricultural sector.

- Since establishment of OFT, the access and usage rates have remained low. Although usage rates need to increase markedly to achieve optimum levels, the current results were assessed as being mitigated by a number of key factors including:
    - the early stage of development of OFT. The process of establishment and piloting of the project impacted on levels of usage in the first twelve months of operation. However, the focus on project development, information sharing and resolution of implementation issues was viewed as a positive process, and one which was pivotal in shaping project extension and consolidation;
    - the small scale nature of the OFT pilot (it comprised three grower groups), while appropriate and necessary for the initial stages of OFT development, resulted in limited awareness of OFT at the national level. As more groups become part of OFT (with numbers having grown from three to 20 in the last year, 13 of which have already been published), the rate of usage is likely to increase accordingly. This assessment is validated by the fact that usage levels have been increasing consistently, and in parallel with OFT expansion levels.

  These issues mean that reliance on levels of usage as a sole or primary measure to determine adoption success is flawed because usage is mitigated by the context and demands of early stage implementation of OFT.

- Despite constraints on uptake linked to early stage implementation demands, analysis of usage figures show that even though the overall number of users for the data collection period was found to be low (3765 users for 9253 sessions) the percentage increase from the first 3 months of data collection (June –August 2014) to the last 3 months of data collection (December 2015 – February 2016) was 565%. The high level of percentage increase occurred in a continually upward usage trend from point of establishment to point of data collection and analysis.

- The low usage rates do not translate to a negative view of the value of OFT, since 100% of those involved in the interview component of the data collection assessing that OFT is valued and needed resource to support informed decision making by key stakeholders in the grains sector of agriculture.

- OFT was assessed as having a high potential for success because it uses localised agronomic data, encourages and supports end user input, and, by using data sets that remain with their custodian groups, ensures that there is no loss of local relevance and ownership. This building of a collaborative platform, in addition to ensuring that the content of OFT has maximum relevance, has also been instrumental in facilitating the development of feedback loops between the OFT team and participating groups. The existence of strong feedback loops was assessed as being instrumental in collaborative issues identification, clarification and resolution.

- The strengths of the OFT design were identified as being:
    - ease of navigation;
    - the search function;
    - the user friendly interface;
    - speed of access; and
    - the visual display and presentation.

  Although there were criticisms raised by a small number of research participants relating to these design features (one individual felt it was clunky, another that manoeuvring through the maps was difficult and another did not find OFT particularly visually appealing), the feedback overall on content, presentation and useability of the technology was positive. Other valued components of OFT, as determined by both interview participants and survey respondents were:
    - the filtering tool;
    - access to the original trial reports;

- the map search function;
- the trial summaries;
- legacy data; and
- the capacity for comparison across trials and across locations.

The fact that these elements were raised by both survey respondents and interview participants on a number of occasions, both within and across interviews, highlights the value placed on them by end users.

The need to maximise mobile access to OFT was identified by end users as an important part of increasing use of the resource. In 2015 CeRDI responded to the need for enhanced mobility through responsive design work undertaken to achieve mobile compatibility. This work has enhanced levels of mobility, although the amount of data that needs to be accessed can result in mobile access achieving less than optimum results, particularly in instances in which internet connections are not strong. This is an ongoing program enhancement task for the OFT team.

- There were variable assessments made across the data collection pool in relation to quality and the importance of quality assurance in relation to OFT. Three dominant themes emerged in terms of this issue: (i) high quality and high trust; (ii) low quality and low trust; (iii) and buyer beware.

1. High quality and high trust: this group showed that those who had been involved in the building of the data sets were more likely to assess that they had a high level of trust in the resource and that they believed that the quality of the data could be rated as high. For these participants, OFT provided good quality data across key areas of relevance to their practice, and they stated that they felt confident in using the information to support the process of decision making. Within this group it was identified that, while local ownership of information was likely to enhance confidence in the quality of the data, there were also transitional issues in releasing control over the information, and making localised information available at the national level. There was some struggle associated with accepting the need for a doubling up of information and moving toward understanding the additional benefits that could be gained through a nationalised system. These issues were resolved reasonably quickly but signalled areas that need to be accommodated as new groups become part of OFT. There was also the identification that ongoing recognition of data ownership and the contribution of local groups and communities was important for trust building and sustainability of collaborations.

2. Low quality and low trust: this group was comprised of a small number of research participants who argued that there needed to be more transparency in regard to the quality of different trials. This assessment was made within the context of maximising scientific rigour and ensuring that users were aware, from the outset, of the strengths and shortfalls of different trials and different data sets. In this group there was the call for the implementation of strategies such as: (1) pre and post testing of soil, growing conditions and sowing methods to enable informed and accurate trials results comparisons; and (2) a quality rating system to ensure that any comparative work between and across site locations and trial type could be undertaken within the context of understanding differences in levels of evidence. This would be a legitimate and measurable way of enhancing the capacity to achieve genuine comparability.

3. Buyer beware: this group argued that OFT provides a unique, and previously unavailable, opportunity to access a range of data sets. Those in this cohort, comprising approximately a third of the research pool, argued that the providing only data of a set scientific quality can be exclusionary. For this group, the allocation of a rating scale ran the risk of excluding data sets that, if accessed, would be beneficial in building an overall understanding of, and insights about, a range of issues of importance to the agricultural sector. Additionally, data custodians were viewed as having

responsibility for making professional choices around what should, and should not, be uploaded for public access. Individuals and groups were assessed as having the capacity to make their own choices around data quality, with decisions to rate (and potentially exclude) data potentially limiting the options available for informed decision making. Buyer beware was a theme for this sub-set of participants; - people are unlikely to choose a single data source for decision making and OFT, while viewed as an important new industry standard, was still only one part of knowledge building.

Overall there a range of views around the quality of the data sets contained within OFT and the extent to which they can reliably be used for research and for practice decision making. These views are not mutually exclusive but are part of a range of views that need to be understood and, wherever possible, accommodated, in order to address the complex quality jigsaw. The overall summary for the elements relevant to Level 1 (Primary Impact) assessment that were addressed and rated in this section of the report are listed below in Table 4, together with their overall rating (and a very brief summary of rational for the assessment given). Only six out of the eight elements were able to be rated based on the data gathered in this sub-section. Other elements will be considered in subsequent sections of this report.
Readers are reminded that all rating will be consolidated into one figure in the Study conclusions and recommendations section of this report

Table 4: Ratings for elements tested for impact in Section 4.2

Area reviewed for impact assessment	Rating given	Rationale
Level and frequency of usage	2 Assessed as needing further development but still working toward the middle point of development	Based on the survey and interview data mapping usage rates for OFT were uniformly low across data collection methods. The rating given was '2' as the level of usage has shown a consistent increase across each month since establishment, with an emerging upward usage
Assessment of data quality	2.5 Assessed as moving toward the higher end of the ratings spectrum	Based on a cross referencing of outcomes and the continuum of rating for quality – from very high to lower levels – and a significant number rating in the middle. However, as Wave 1 research is measuring for *Primary Level* impact the focus is on the criteria set for this level. This criteria calls for a rating of 3, which is that 'the quality of information, as assessed by end users, was consistently viewed as being of a high standard in terms of meeting user needs and, in instances where there is a quality issue, end users see this as a collective issue and ensure that this is addressed through provision of feedback and/or the provision of new information, as required. To accommodate the fact the variability in views (albeit for small numbers, the rating was downgraded to '2.5'. This will be monitored and modified in the next wave of data collection.
Usability and navigability	3 Assessed as being at the highest point of attainment for this level of impact	Based on the survey and interview data mapping, which identified a high level of positive feedback for the information contained on OFT. The portal has visual and capability aspects that are unique. Navigation is intuitive and the data sets enable the presentation of spatial maps, grains legacy data, and cross site comparative data. The visual aspects of the portal are presented in a way that enables the user to access information that captures what they view as integral to informed decision making.

Area reviewed for impact assessment	Rating given	Rationale
Participant experiences of the innovation	2 Assessed as at a middle point of development	The rating for participant experiences of the resource was good across both survey and interview data. There were some examples of instances in which users had had a positive experience when access or working with OFT. There was a reasonable indication that OFT may be assessed as a valuable resource or one that had potential to have relevance for end users into the longer term. There was some reasonable indication given that issues or concerns identified with OFT had been critically reviewed, with the aim of putting in place measures to address these.
Level of support and feedback provided by the OFT team	3 Assessed as being at the highest point of attainment for this level of impact	Based on a content analysis of interview data in which the consistent feedback was positive on this variable. No negative feedback on this issue was recorded. There were clear and well documented processes and/or mechanisms in place to facilitate the allocation of roles and responsibilities and to establish processes of inclusiveness across end user groups. The nature of these process could be assessed as being likely to result in high level of end user confidence in the support structures offered through the OFT implementation team.
Trust in the resource	2 Assessed as at a middle point of development	Based on a cross referencing of outcomes the continuum of rating for trust – from the very high to the lower levels – and a significant number rating at the middle of the continuum. There were a range of examples found, throughout embedded feedback mechanisms and through research processes relating to end users trust of the content and applicability of OFT. There was a good level of confidence expressed that the content could be used to inform decision making and to expand knowledge through legacy data and comparative analysis of locational differences.

4.3 Unique attributes changing sector capabilities

As part of examining the 'readily measurable' elements of OFT, such as usage, perceptions of quality and views about the need for the resource, a number of important insights specific to the unique elements of OFT began to emerge.

The following section of the report presents findings on these attributes and the ways in which they have been identified as having the potential to change existing capabilities across the sector.

4.3.1 Legacy data and building sector capacity through comparability

The most consistent theme to emerge during data collection across both survey and interview data was the value of legacy data and the subsequent type of impact on decision making this attribute was likely to have for the grains sector. All survey respondents who had used OFT, and thirty-two (86%) participants involved in interviews identified one of the key benefits of OFT was that it allowed end users to access legacy data.

These assessments on the value attributed to legacy data are captured in statements such as:

> *"The legacy data is something amazing – if you are a farm consultant or research agronomist it is an amazing resource" [Interview participant: GRDC panel member].*

Legacy data refers to data from the past – the earliest trials on OFT are from 1993. These are farm trials data that have previously only been available in hard copy versions, and to members of individual grower groups.

Although access was possible, the housing of the data for different years in separate hard copy form limited easy access because of:

- the number of full trials to work through in order to find past results – particularly in instances in which there was no ready cataloguing system around which year the trial (or trials) of specific interest occurred;
- the lack of capacity for immediate comparative overlays – when this is a process that needs to be undertaken manually it is very difficult (though not impossible) to readily make data discoveries, to identify trends or to identify anomalies; and
- the fact that each grower group often had ready access only to the trials that occurred within their own grower group. This made cross referencing of trial data across locations and trial types difficult. This was particularly problematic as there was no easy grower group-based cataloguing method in place to identify which other groups might have trial information of relevance.

The feedback provided by those involved in the interview process, and through survey data, was very clear and definitive in that the capacity to access legacy data was a main attribute of OFT. It enables grower groups to access information that had never been able to be accessed before in such a user friendly and immediate way.

This was viewed as particularly beneficial for a range of reasons. These include:

- enabling agronomists, extension officers and growers to gain insights into information that they can add to the complex equation of decision making. This level of knowledge building and information exchange was previously unavailable for those without ready access to resources such as:
    - finding data bases outlining which grower groups had been funded for what farm trials – at a local and national level;
    - original data sets; and
    - a catalogue of the type and number of farm trials that have been run at the national level.

Removal of these types of barriers to information exchange enhances the potential for localised empowerment and engagement (through information sharing, greater acknowledgement of the value and applicability of locally developed trial data) and more informed decision making.

The ability to achieve this type of knowledge sharing is further enhanced when the mechanism for accessing information is simplified, as is the case with OFT – an intuitive system that, in simplicity enhances usability.

> *"… from the point of view of the product itself, um it's a fairly simple product, um and you know the idea of using the KISS principle in terms of the product itself is really I guess encouraged because as we've found from other training activities with farmers and advisors is the more complex you make it the less likely they'll use it. And we've heard that in market research, we've heard it in training, they don't want to have to learn a new product, we live in a world where there is information overload and there's lots of conflict in terms of quality and accessibility to material. Um, so a strong onus has been to simplify the process, to make it so intuitive that they almost don't need to be trained in the system. And I think to date that's been achieved" [Interview participant: GRDC staff].*

> *"It's handy if you are starting a new project or wanting data about a particular topic it saves flicking through you know 10 results books and finding individual reports. You can just say everything that's related to nitrogen and you get across years and across grower groups if you want. I guess that's what I've found if helpful for, getting a bigger picture of the data that's available" [Interview participant: grower].*

Notably, enhanced access to data provides capacity (albeit still theoretical) for a paradigm shift for how planning and development for the grains sector is approached. The extent to which this occurs, and how this will be managed, will be tested over the following waves of data collection for this study.

- Creating a capacity for ready comparability across data sets. This comparability, within the context of data overlay, enables previously hidden trends to be captured in a way likely to build capacity through the establishment of both new insights for the grains industry and the creation of research ready data sets that, now available, can be explored and new data discoveries made. These type of data discoveries have significant implications in terms of both research and industry knowledge building.

  > *"being able to compare to other states, I don't have the knowledge of where those areas are very well, so if you could find an equivalent rainfall zone that might be something that um yeah, that I'd be interested to compare, see what their um like different issues are and how they're addressing them" [Interview participant: grower groups].*

  > *"In your local area the results are saying this, so you go, well okay that's one trial. If you could go and find more trials to suggest the same thing it would give you a bit more confidence and a bit more strength to either make a practice change or not make a practice change… the compare and contrast, the systematic review of similar conditions, similar trials and consistent findings so that you, you know, you'd be able to make a much more, well a more confident decision" [Interview participant: grower group].*

- Enabling the building of an interactive repository of information. This will include information across extended timeframes, across locations, through trend identification and, eventually, through new data discoveries. Additionally, however, while this was valued as an important part of OFT – what some interview participants referred to as 'a complex and needed filing system' (see full quote below) – it was also identified that this was only a starting point for further product development. It will need to be a key focus of OFT development into the future and is an area that must be tracked in subsequent waves of data collection for this research project.

  > *"The biggest issue I see going forward is how we make the tool alive I guess, rather than being a reference product. So we don't want it to just be a knowledge repository that people have to actually physically actually go in and search. It's got to be driven by personnel. It's got to have people with expertise to actually say, we've got problem X in the field this is what the product offers in response to that and we use the appropriate channels to get the message out, not only to growers themselves but also that people that informs them" [Interview participant: GRDC staff].*
  > *"Need to move it beyond a glorified library (filing cabinet). Even as a storage system it has real benefits for agronomics but there needs to be developmental work to give it life and capacity to compare and incorporate other types of data" [Interview participant: GRDC staff member].*

- Minimising unnecessary trial duplication: though targeted duplication can be valuable for findings replication and validation, duplication caused by a lack of knowledge of what has been done previously is problematic. Duplication of research activity is a major issue across sectors, particularly in a resource poor research environment. Whether the sector be health, social services, agriculture or science, the call for decreasing the potential for research duplication is growing (Colpas, 2013; Committee on Agriculture, Nutrition & Forestry, 2013; Kamut et al., 2015; Mathews et al., 2013; Primary Industries Standing Committee, 2011; Winden et al., 2014).

  Duplication can occur for a number of reasons, not the least of which is the lack of access to legacy information – a particular problem when key personnel leave a work environment and large amounts of historical data around work undertaken previously are lost. This can include knowledge of the location in which trials occurred, the outcomes achieved, the years the work was undertaken and the relevance of insights gained to industry practice and localised decision making. While none of this data is lost, the conduit for ready transfer can be lost and duplication can occur as a result of this.

  > *"Quite a lot of stuff is done and either goes in a book or a report somewhere, that someone may not have easy access to and therefore it can't be accessed. You know what I mean? So I think the legacy aspect is much about the people generating the data so that there's a home somewhere for it. And a*

good example is um, the GRDC fund what's it call? Regional Cropping Solution Networks and they run sort of small trials and they really have no mechanism apart from say running a field day and putting the notes out to have any of that information stored and accessible for someone. They don't have their own website, they don't have you know anywhere else, any databases that can be stored on. So I think that's a real positive. And I think the more groups and consultants and advisors and companies start to understand the legacy of it, I could quite easily see in the future chemical companies say putting some stuff on there because you know they've done these trials with 10 different herbicides and it's a replicated trial and it's got all the statistics and it's a way if they feel positive towards it they could put that there so if someone wanted to find out about a herbicide or something, here's the trial data" [Interview participant: agricultural consultant].

"… one of the things that happens in the industry is that lots of people are doing the same research in tandem, and don't necessarily know about it. So if you can query a database and say well what actually has been done on this in the past? And I think GRDC would need to use it for their project, whether they fund or not, for the next projects. Like so many times research is just rehashed. It's happening at the moment in a big way, like with the new weeds research. But out of this, like a couple of projects that we're involved in we're finding that there's been lots of research been done but in different ways so the value of that research is only specific for that situation and that gets back to what Tim's saying, is regionally specific things. So you can't really combine the data, but you can look at the data separately and compare. Yeah, so that's important" [Interview participant: grower group].

- Mapping the scope of knowledge across the grains sector. As identified, the practical benefits of minimising duplication are enhanced efficiency and greater understanding of what has already been done – and what needs to be targeted for further work. A linked benefit to this, but an insight valuable in its own right, is the capacity to have a system which allows for an immediate visualisation of research expenditure in the grains space. An important starting point for ongoing research and development.

"I guess one of the strengths I didn't really mention is like the history, like the history of the work that actually has been done, that it does actually go back so far it's an amazing source of information that's yeah, one of my little notes… It's an incredible reflection of how much has been invested into Ag research" Interview participant: grower group].

These unique attributes of OFT were identified consistently across the data collection process – both in the survey and, most consistently, through interviews – as the key strengths of OFT as a valued initiative likely to strengthen the grains sector into the longer term. Figure 11 shows the interconnections and the movement toward the building of a unique tool with a range of significant attributes while the following sub-section of this report will examine perceptions from research participants of the capacity of OFT to shape decision making in the sector.

Figure 11: The attributes that build uniqueness

4.3.2 Building the potential for informed decision making

In the previous sub-section of this report, the unique attributes of OFT were examined: the increased capacity for access through simplification of data management processes; through minimising duplication and through having in place a repository of key farm trial data sets – with the goal of using legacy and capacity for comparability to, over time, bring alive the data to inform research and decision making in a range of different ways.

This sub-section includes an examination of the emerging developments (and participants' views of potential into the future) relating to the use of OFT for informed decision making in the grains sector as a result of improved access to farm trial data.

This issue was, in the first instance, explored through the survey process. It is acknowledged that survey participant numbers were low; however, it is also important to recognise that those who were involved in surveys were agricultural professionals who used farm trial data on a regular basis to inform and shape their work. This meant that those survey responses that were received were made in an operational context, and with a clear reflection on decision making potential of OFT (as one resource against a range of practice support resources available to respondents).

Survey respondents were asked to rate the extent to which the availability of information on OFT added value to their decision making. This decision making could have occurred in regard to projects they were completing, in terms of forward planning and/or in terms of information provision to growers around previous trial data. The areas of information provision which the respondents were asked to rate were:

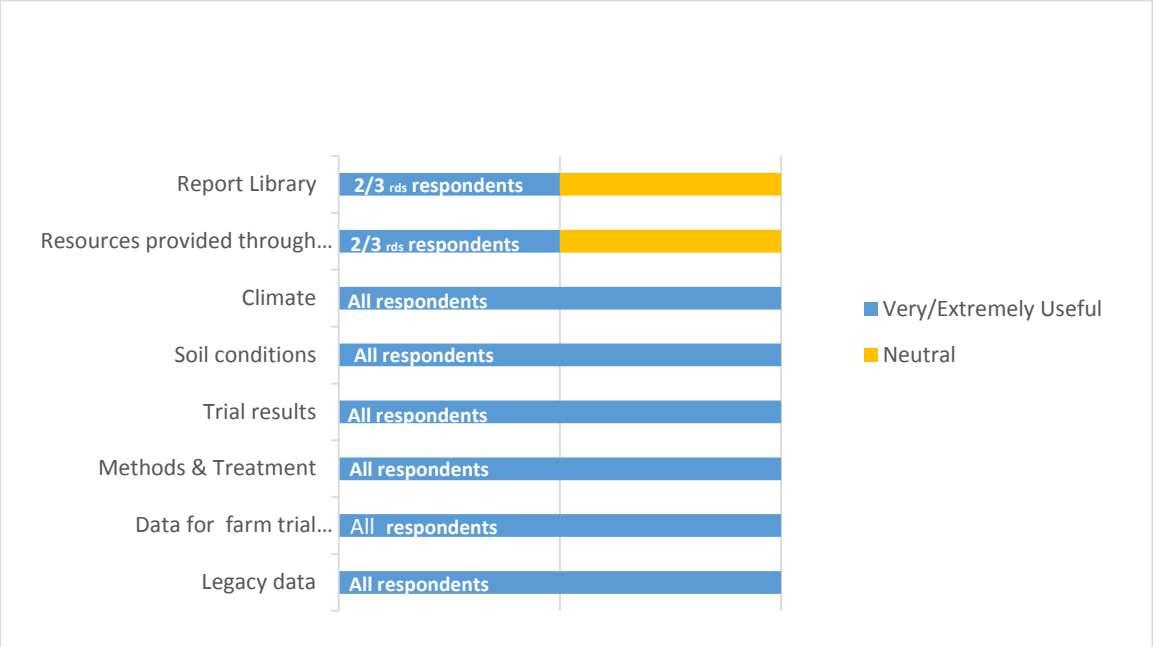
- the Trial Explorer
    - method and treatment;
    - results;
    - soil conditions;
    - climate;
    - resources provided through links and attachments; and
- the Report Library.

With the exception of one 'neutral' rating for 'resources provided through links and attachments' and one 'neutral' rating for 'Report Library' the survey respondents gave a rating of either 'very or 'extremely' useful to these elements of OFT in supporting their decision-making processes. It is important to overlay these assessments with the consensus reported on in the previous sub-section of this report relating to legacy and comparability data for supporting and enhancing the decision-making process.

Those who completed the survey indicated that OFT provided potential decision making support that was not available in the past and was a resource that they were likely to use increasingly into the future.

The combination of these data findings for decision making are captured and presented visually in Figure 12.

Figure 12: The value of elements of OFT for enhanced informed decision making



When these assessments were triangulated with the data collected during the interview process, there was a consistent trend indicating that end users saw potential in OFT for enhancing decision making – particularly for problem solving – as identified in the following extracts of interview, and, very specifically in two case studies provided overleaf.

Responding to a specific issue:

"And I think you will get farmers in when they know a bit more about it. The guys that we have been talking to that have had a look, it's like they'll have an issue on their farm and they'll know, say about fungicides, we had quite a disease problem this year and it's unusual for our area. So for them to be able to access results from other trials throughout Australia I think that's you know starting to get excited about looking at it" [Interview participant: grower group].

Comparative data and decision making:

"if you can get online and see trials from all around Australia and something. And if there's a trend that emerges across all of them then it's fairly fair to say that if you were in a similar or even if you were in a different environment if the trends the same then you're going to get, you can't expect to be going the opposite way. So I mean, information is power. Even if you look at something and then discount it, not do something it's worthwhile. It all helps in decision making" [Interview participants: grower].

Decisions can come from both what does work and what doesn't work:

"Because it allows you to get to the information that informs the decision fairly quickly… and that might be 'gee it doesn't work'. You know, but that's still an informed decision. So I think it's, the concept is about this informed decision bit. And I think the tool has got potential to inform those decisions, and that might be that they change something, or they might know I've looked at you know this fertiliser on 10 different trials and the gains are only a few percent. You know and that might be some of them aren't statistical, some are you know so they're significantly different but it's only 3% or 5% and you think well that costs another $50 for fertiliser with only a 3% return, it's not worth doing. So I think as long as you

accept that it can do some work both ways, so you might not actually see a change in practice, but it's still been useful to inform a decision. So I think that, yeah, the answer to the question is does it inform, will it inform decision making" [Interview participant: agricultural consultant].

Case Study Number One

Applying OFT to decision making: a nitrogen case study

"And we were playing around and looking at malting barley to feed barley, so two different types of barley you can grow, so malting barley has low protein and both low protein usually means there is a restricted level of nitrogen in the soil which reduces overall grain yield so the quality to make beer out of it you actually want something with low protein not high protein. If it's got high protein it goes to the feed market and historically the feed market has been a lot lower in price than the malting market and the beer market. But we were tossing around that half the time or three quarters of the time we thought we were getting protein levels above what malting barley should be, so high protein levels. But we were restricting the amount of nitrogen we were putting on so we thought are we being dumb here would be far better to pour heaps of nitrogen on, grow a lot more tonnes of barley and just accept the lower price. So we went to, we did two things, we went to the price guide and found the various differences between prices, relative prices between the two. And then went to the Online Farm Trials there and quickly searched any barley trial so we looked up barley for our part of the world, and we wanted barley trials that had grain quality information and narrowed that grain quality information down to protein. So we could actually see the response to nitrogen for grain quality. And we ended up with 17 or something or 13 that were of value and we got there within 2 or 3 minutes. We wouldn't have persevered to find a trial, go back to the results book and you know read through a results book until we found something 15 years ago. We just wouldn't have spent the time on it. And this allowed us to pull out the information we wanted very quickly, put it in Excel, do some graphs, get rid of some things we didn't like because we thought oh that's a bit skewed or that was a drought year, so we could pull certain things apart. Then, with the price guide, we were then able to look at it and thought we're far better to be advising people to just grow as much barley as you can and pour the nitrogen on, it a good year you'd be far better off than trying to get malting. Um, so that was a useful bit, a useful application of the tool because we had a specific question we wanted to know

Case Study Number Two

Applying OFT to decision making: using the past to inform the present

"Um, now to give you an example (name given) she was doing a lot of lime work for us ... and one of the farmers was putting a, a pulse crop in, so a legume crop in and she couldn't find any information, or was wondering what sort of response might I expect from a you know a lime crop, a from a pulse crop with these lime applications. She went to the Online Farm Trials and typed it in and there was one trial in 2000 that Southern Farming Systems had done. So she got to that within seconds. And look the method and you know what rates were put out and all that sort of stuff. Um there was only one trial there but that was pretty handy to actually know, and then be able to pull up the results and just read what happened. So that was just handy. So I think from a research point of view thinking who's done what work, geez this work has already been done in Western Australia I didn't realise that much had been done. So I think the application is answering questions and then in the design of sort of trials and experiments and you know um, researching new things... (need) to show the value of that, accept people, prove the value of that

This overall feedback, across both interview and survey data, regarding the potential for OFT to inform decision making is positive. Participants consistently reinforced that OFT is a resource that, through legacy, comparability and issues specific information, contains elements that are very important to enhanced decision making. This is an important initial indicator of success – albeit one that needs to be consolidated into the longer term to become a definitive impact assessment.

> *"As I say I pushed them a fair bit, I see a lot of value and opportunity that can be created through this, if you get buy in early and help shape it you can either try and shape, the way metadata and the whole thing, as I say you can be there and hold the tide back pretend it's not happening or you can buy in actively and try and shape it so that's always been my philosophy in this space. So I sort of pushed the staff staying we're going to do it, and then left them to their own devices a bit. But I sort of, so I was the thing, and it's something I think is very important, that the opportunity that's going to come, a way, from converting this data into knowledge and allowing some causations to occur is going to be valuable" [Interview participant: grower group].*

Although the range and scope of this programmatic feedback was positive, the feedback provided at this point of development and roll out of OFT around the potential for economic benefits being gained through the use of OFT was less definitive.

Analysis of data, across all data types, indicated that there was not enough confidence in the content and potential of OFT for it to be used to drive decision-making processes based on potential economic benefits at this point of development. This is not an unexpected finding but one that needs to be noted. This is particularly important because data analysis indicated that there is no clear measure within existing OFT data collection and data roll out processes, for measuring economic impact. As the impact of OFT in achieving economic benefit is an important part of overall impact assessment, this is an issue that will need to be a focus of both future research and future program development strategies. To this point of implementation, participants indicated that they would not make decisions that would have an economic impact based on the content of OFT. This assessment is countered by two things: firstly, OFT was considered to be a part of a larger decision-making process. This is a positive first step which is closely aligned with the 'buyer beware' philosophy discussed previously in this report; an approach within which OFT is one of many decision support tools.

> *"Would not make economic decisions based on OFT. Data is drawn from lots of areas – not just one. OFT is only one element of a complex matrix so too hard to make a direct correlation between one and the other" [Interview participant: GRDC staff member].*

Secondly, was the fact that the potential for economic influence of OFT was recognised and acknowledged by interview participants. The evidence for this is found in the following two extracts of interview, one of which has already been used in this section, but is used again as it contains a very specific example of the inclusion of economic considerations in the decision-making process:

> *"… the potential productivity savings, I think it would be. If a farmer was to, with that decile function, that could influence his spraying, his nitrogen application, whether to cut for hay or not, so there is that potential there I think… we need that further development to get to that point" [Interview participant: grower group].*

> *"… I think the tools got potential to inform those decisions, and that might be that they change something, or they might know I've looked at you know this fertiliser on 10 different trials and the gains only a few percent. You know and that might be some of them aren't statistical, some are you know so their significantly different but it's only 3% or 5% and you think well that costs another $50 for fertiliser with only a 3% return, it's not worth doing. So I think as long as you accept that it can do some work both ways, so you might not actually see a change in practise, but it's still been useful to inform a*

decision. So I think that, yeah, the answer to the question is does it inform, will it inform decision making" [Interview participants: Agricultural consultant].

This feedback indicates that economic impact has not been a central point of consideration of OFT roll out to date, but is beginning to be considered in the impact and usage equation – a good point with capacity for further development.

In summary, acknowledging limitations in terms of economic influence and benefits, the overall positive feedback around decision making and OFT is a key finding in terms of future expansion and application of OFT. It is important to overtly state this as a key finding of Wave 1 research and one that must be tracked over subsequent waves of data collection for this current research project.

One consistent theme was the critical importance of ensuring that knowledge about OFT and the potential it holds for the grains sector, was made known to the maximum number of stakeholders in the grain sector as a matter of urgency.

"The real challenge is really encouraging the momentum and getting people on there, and to some extent you know, we've got a good system here which is a great resource, the real challenge now is really getting people to want to rely on that as a tool for making decisions" [Interview participant: GRDC staff].

The issue of maximising the reach and capacity of OFT into the longer term is the focus of Section 4.4 of this report.

4.3.3 Findings summary: examining the 'unique attributes' and changing sector capabilities

Section 4.3 focused on examining the attributes of OFT that were likely to enhance the potential for key stakeholders to be supported in the decision-making process. The data presented in Section 4.3 drew on both survey and interview data and these methods provided some valuable insights into what data the grains sector believes are important to informed decision making. The key findings relating to this issue are noted here.

- The high value placed on the potential of legacy data for shifting the decision-making process and allowing greater pools of critical data to be included as a matter of best practice. The potential to access legacy data was particularly valued because it was a mechanism through which to overcome previous barriers to informed decision making caused by:
    - the quantity of hard copy reports that needed to be reviewed on an individual basis in order to find trends (or even just individual trials) manually;
    - the lack of an open access farm trials cataloguing system across timeframes and across locations – which meant that, even if stakeholders were prepared to review data held in individual hard copy reports, it was not easily possible to know what was available and where the data was held; and
    - the subsequent inability to readily compare and contrast farm trials across zones – both locational and time.

  OFT was viewed as a tangible mechanism to address these – through the power of legacy data. The key benefits of overcoming these issues through the access to legacy data were identified as being:
    - building a repository of trial information – a filing cabinet holding all trial data in a way that was not possible in the past. This was viewed as a critical starting point for enhanced decision making - but by no means the end point. The digital 'filing cabinet' was viewed as the foundation through which to make the data come alive for end users – enabling them to use legacy and comparative capacity to shape decisions in a way that was not previously possible;

- the fact that there was now a simplified system for agronomists, extension officers and growers to access information across previously quarantined (by grower group boundaries and data storage approaches) trials spanning time and location zones;

- the subsequent creation of a new capacity for decision making which, as a starting point, could be informed by accessing pools of data that were user friendly, used non-scientific language and allowed for compare and contrast was viewed as a major advance. An advance that would ensure that end users were able to maximise their knowledge and readily draw on all available data of relevance to their decision making; and
- the ability to minimise trial duplication through an enhanced knowledge base of what has already been done. This was also viewed as a way to maximise efficiency in research funding and to drive an increased focus on meeting knowledge gaps through targeting new farm trials for identified knowledge shortfalls.

  The value of legacy data for mapping the scope of research and development in the grain space was also identified as an emerging benefit of OFT.

- Emerging assessments of the usefulness of elements of OFT for shaping decision making by research participants. The OFT resource areas identified as useful for decision making were:
  - methods and treatment;
  - trial results;
  - soil conditions;
  - climate; and
  - resource and the Report Library

  The fact that strengths for informing decision making were identified across so many elements of OFT was an important finding of the research. Data collection tracked and presented the early emergence of examples of the use of key elements of OFT in the decision-making process (these are presented as case studies in the body of Section 4.3).

  Particular points of usefulness of the information on OFT for informing the decision-making process were identified as being:
  - providing an increased capacity to respond to a specific issue – based on an increased capacity to search and filter to gain insights around the issue under consideration;
  - allowing a previously possible availability to comparative data; and
  - having a simplified mechanism to track what has been successful and what has not. Knowing what not to do was considered to be valuable because it allows a process of filtering and informed elimination (or inclusion) and subsequently strengthened the depth of the decision-making process for the end user.
- There is limited capacity, at this point of OFT development, to use OFT to make decisions that are likely to have an economic impact. Participants identified that information that has the potential to deliver economic benefits would be welcomed in the grains sector and amongst key stakeholders. There was however no measure in place, at this point in the data collection process, to determine economic impact of OFT. Examples of ways that OFT might deliver economic benefits were provided by research participants, and potential decisions driven by economic imperatives were explored. It is clear that work will need to be done to develop economic modelling for inclusion in the subsequent waves of data collection for this project.

The overall summary for the elements relevant to Level 1 (Primary Impact) assessment that were addressed and rated in this section of the report are listed below in Table 5, along with their overall rating (and a very brief summary of rationale for the assessment given). The remaining two out of the eight elements were rated based on the data gathered in this sub-section. Additionally 'participant experiences of the innovation' is again included for rating as there were data findings in this section of the report which are of relevance to this elements of Level 1 (*Primary Impact)*.

Table 5: Ratings for elements tested for impact in Section 4.3

Area reviewed for Impact Assessment	Rating given	Rationale
Potential for further development	2.5 Assessed as moving toward the higher end of the ratings spectrum	The information provided through interview data highlighted a range of unique capabilities that indicate a forward movement toward positive OFT development. This meets the requirements for Level 1 and it was identified that there was an overt and consistent message provided that participants could identify the potential of OFT (either currently or in the future) to be used as a resource with capacity to enhance and support future development initiatives within the sector and/or for research and data discovery and a framework for building characteristics and capabilities likely to be beneficial to the grain sector into the longer term. A full rating of 3 was not given based on findings around development work that needs to be undertaken (and detailed in Section 4.4 of the report
Usefulness of the content	3 Assessed as being at the highest point of attainment for this level of impact	Based on the survey and interview data mapping which identified a high level of positive feedback for the information contained on OFT. There were consistent and significant examples of usefulness or potential usefulness of OFT content in supporting and meeting the needs of the individual and the sector for planning and decision making Additionally, the majority of participants rated OFT as being extremely useful in terms of legacy data and comparability of data sets
Participant experiences of the innovation	2 Assessed as at a middle point of development	The rating for participant experiences of the resource was good across both survey and interview data. There were some examples, of instances in which users had had a positive experience when access or working with OFT. There was a reasonable indication that OFT assessed as a valuable resource or one that had potential to have relevance for end users into the longer term. There was some reasonable indication given that issues or concerns identified with OFT had been critically reviewed, with the aim of putting in place measures to address these

4.4 Maximising capacity into the longer term – a focus for change

The previous sections of this report have examined research participant assessments of the existing components of OFT, the value they add to the grains industry and the specific attributes of the resource that were assessed as likely to enhance capacity for informed decision making for key stakeholders. This final section reports on examination of the feedback provided in relation to the ways that the reach and sustainability of OFT in the future can be maximised.

4.4.1 Identifying the target audience at this point of resource development

One of the dominant themes to emerge around longer term development of OFT during the data collection process was the issue of target audience for this technological innovation. The objective of OFT was to provide a resource for all key stakeholders in the grains sector, and a component of the research process was identification of the extent to which this objective was able to align with the needs of the targeted end user base.

There is no question that discussion with the OFT team, when triangulated against the documentation for the establishment of OFT, placed all key stakeholders as equal end targets for use and application of the resource. The data collection process identified a number of issues and highlighted the need to reconceptualise roll out of OFT. Initially, there were some assumptions made around the universal application potential of OFT, the research has highlighted that, certainly in the short term, and potentially into the longer term, this assumption needs to be re-examined. This need is shaped by the nature of planning and development processes in the grains sector, particularly in states such as Queensland and New South Wales, where the use of agricultural consultants is an embedded part of work practices.

It has emerged that agricultural consultants play an important role in the grains sector, and influence grower decision making in a range of ways and at a range of levels. A consistent theme identified in data collection was that of questioning 'who is OFT for?' Is it for the grower, or is it for the agricultural consultant? Is it for both? Understanding the profile of end users emerged as a key issue. The OFT had always conceptualised the resource as being for all stakeholders and although this remains the driving philosophy of open access to critical decision making information, the identification of major users over the short and the longer term is an issue requiring some consideration, given the need to maximise the capacity to embed OFT as an integral resource in the grains sector.

On the issue of the likelihood of OFT being used by growers themselves, even into the longer term, there was a dichotomy of view. One group of research participants believed that this was unlikely and that expectations that this would be a grower resource were flawed. This group of research participants assessed that, regardless of point of roll out (early or late stage), the dependence on the agricultural consultant and/or the grower group extension officer, was an embedded part of work practice. This meant that, within this scenario, the agricultural consultant would always remain the target audience for the uptake of OFT. This view is captured in statements such as:

> *"The most likely group is consultants and grower groups – farmers use google and you need to be able to find OFT when you google but while you target advisors as a matter of urgency there will be transmission over time" [Interview participant: GRDC panel member].*

> *"I'd be expecting my consultant to be using this a lot. I know one of the guys that gives us advice looks at the GRDC you know their papers, oh what's happening with this sort of fund right go straight to the GRDC website and have a look at their paper on it, so I'd expect this to just be another resource" [Interview participant: grower].*

> *"I mean I reckon consultants and advisors will tend to use it more because if they are smart about it they could use some of that data. You know we already suffer, as all grower groups do with putting out very cheap data to them and they then sit and use it there at their preseason meetings and sound like their geniuses and we've done all the work. But you know so if they were smart about it they'd use OFT to build that story even more. Which if I was an agro I'd do. So yeah, but there will be growers, I think you'll get more advisors using than growers though" [Interview participant: grower group].*

> *"We [growers] all rely on our advisors because we can't be an expert in every field and we hope that their more cutting edge than we are. And we're going to the field days and searching things on the web and doing all that stuff. But a lot of what you get from a consultant is the sounding board someone to discuss, someone with a slightly different perspective, a broader perspective to discuss your decisions with" [Interview participant: grower].*

This view was drawn from across the participant pool and was not limited to feedback from the agricultural consultants themselves. Rather, it was drawn from all groups who participated in the research (and held this particular view) as one of the consistent points of feedback in relation to uptake.

The second group of participants on this issue considered that, although agricultural consultants and grower group extension officers should be the target group into the shorter term, there were growers who would benefit from OFT, and would use it independently, once they were aware of the resource and provided with some support in use and application.

Those who saw OFT as a grower resource highlighted that there are a number of areas across Australia in which there is limited use of the agricultural consultant. This is often due to a limited capacity to access this type of support or an individual grower resistance to using external supports. In these scenarios the agricultural consultant was not accessed either because they were not available or because, even when they were, there has not been a history or tradition of the use of external support in decision making. In these instances research participants argued that OFT needed to be considered primarily a grower resource.

There are also growers who use agricultural consultants but who also want to manage information access and knowledge building in order to maximise their control over, and capacity to, make informed decisions. For these groups of growers, OFT was considered an important resource.

> *"I have seen that there are farmers who have had bad experiences with consultants and so they have made the decision to not use them and just rely on their own knowledge and experience and this is a resource that they would use" [Interview participant: grower group].*

> *"Would be very keen to be out there with grower groups and get them (as a user) to drive OFT and grow it. You need to involve them for further refining and asking questions such as: are we on track", how is it looking? How can we improve entry and access" [Interview participant: GRDC panel member].*

> *"I think some people, some people rely on, get that reliant on their consultants that they're not game to get out of bed without ringing them first and then other people are inclined to ask their consultants to get his opinion and then go oh I'll make my own mind up. Everyone is on a spectrum between those two things" [Interview participant: grower].*

The third group of research participants who commented on this issue considered that uptake of OFT was likely to be much more staged. Unlike those who viewed OFT as mainly a resource for the agricultural consultant or grower group extension officer, or those who viewed OFT primarily as a resource that needed to be targeted at the growers themselves, this group accepted that OFT would be a resource across end user types.

The feedback from this group emphasised the need for the OFT team to use the marketing and implementation support process to engage consultants and farming system groups and then, over time, allow this first point of engagement to provide the mechanism for networking and trust building. This assessment aligns closely with what the literature has identified is integral to the uptake of innovation in agriculture (Anil et al., 2015a; Attanandana et al., 2007; (Bellotti & Rochecouste, 2014);Llewellyn, 2007; Long, 2011). It is captured in the following representative statements from this sub-set of research participants:

"In the early stages it will be more useful for the farming systems groups because they become a resource for networking, for writing funding applications and for creating partnerships. Once similar agronomic issues and soil types are in then the farmer can learn from what others have learned. Building a picture of what farming systems are doing: A platform for collaboration as the opportunity to build relationships and learn from what others are doing is a great strength, as is the networking capacity" [Interview participant: GRDC panel member].

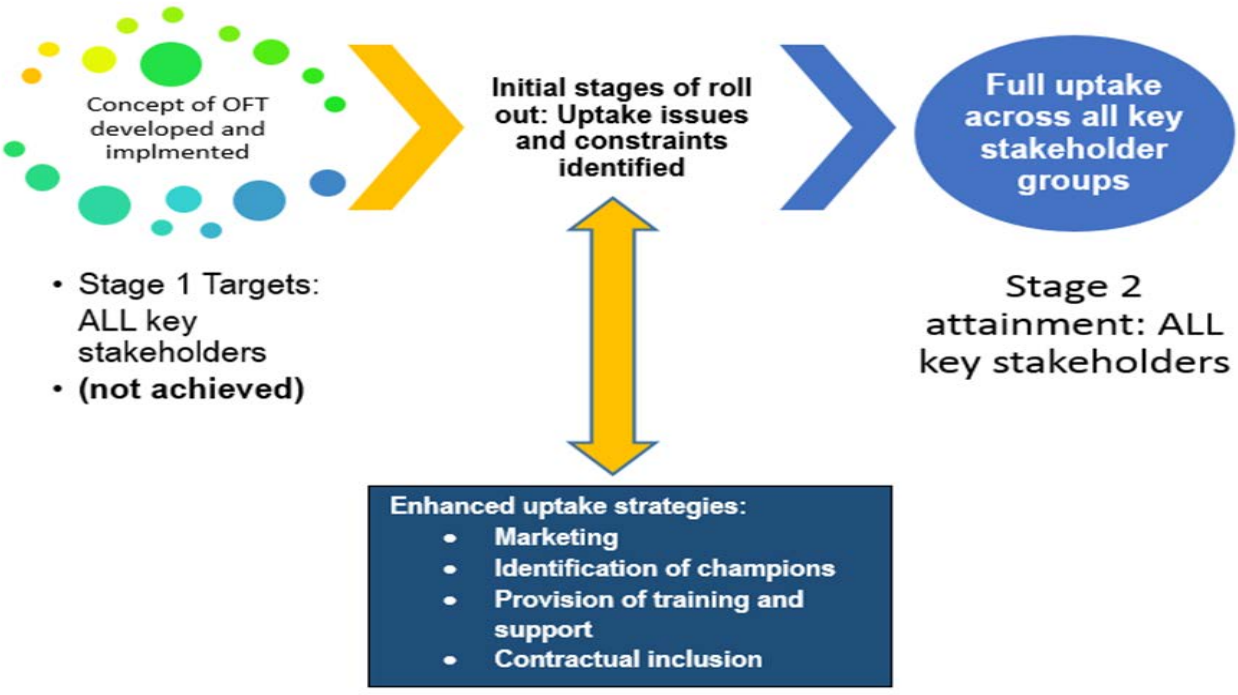
"Expect that 90% of those who will use it, in the shorter term, are the advisors. Without doubt there are a small proportion of interested growers who will examine the evidence but the vast majority will be the agronomists … but this may change in areas where the consultant 'paid model' is not as active (and growers get to find out about OFT)" [Interview participant: grower group].

"Farmers will use it into the longer term. The initial audience needs to be industry and this as a mechanism to get information out to growers" [Interview participant: GRDC panel member].

Regardless of whether the assessment made by research participants was that OFT was a resource for agricultural consultants or for growers, or for both, the feedback provided highlighted that the original (and linear) view that uptake of OFT was, in the main, about availability was flawed. The development and roll out of the resource was an important initial step.

The extent to which the resource is assessed as a positive addition to the sector has been a positive second step. However it is at the point of maximising uptake that the linear model has been shown to have some flaws. It was based on assumptions around the role of grower groups in marketing and of the grower as an end user. The model needs to shift from a linear to a staged approach in which marketing, education, championing and contractual change become embedded components. This shift is captured in Figure 13, and discussion around each of the elements that have been added to the implementation model is discussed in detail in the following sub-sections of this report.

Figure 13: Shifting OFT implementation from linear to staged



4.4.2 Marketing – targeted and structured for maximum outcomes

The capacity to access legacy data and achieve comparability of farm trial data was found to be the most significant theme in terms of content of OFT; however, the most recurrent idea to be raised by research participants relating to ways to maximise the reach of OFT into the longer term was the notion of increasing the marketing for the resource.

The question of marketing was not raised by those involved in the survey component of data collection – 32 out of the 37 (86%) participants at interview raised the need of greater marketing as a central focus area for increasing the reach of OFT. The remaining 5 (14%) identified, as part of their discussions, the need to ensure the building of a greater external profile for OFT.

These views are captured in statements such as:

> *"Yeah the more that people understand how it works, I think the adoption of it, the use of it will definitely increase" [Interview participant: grower group].*

> *"There is this window of opportunity – but you must capitalise on this and make sure that you get as many people on board as possible otherwise you run the risk of losing momentum and then all bets are off. Momentum is critical so it must be picked up and grow as a matter of urgency. Need to make entry easy. Needs to get a momentum of its own so the awareness phase is critical for longevity of OFT" [Interview participant: GRDC panel].*

> *"Just having it there isn't enough – you have to show people the how and why of it all and how it can be used. When I was first shown the potential it had I was blown away and you just need to get it out there" [Interview participant: grower group].*

Importantly, suggestions for marketing were consistently framed around a view that it was a good product and that the issue was one of helping people to hear all about it rather than having to sell a product that had good and bad points. A small group of participants from the GRDC panels, from industry and from the grower groups did emphasise the importance of ensuring that any glitches in the system were ironed out before a concerted marketing process began to ensure that the strengths and potential of OFT was not lost because of technical or presentation difficulties:

> *"Like any new tool needs to be perfect before it is released so that you don't lose people" Interview participant: GRDC panel].*

A range of suggestions were made from across the participant pool around the most effective strategies for marketing OFT. These included:

- presentations and demonstrations of OFT at field days. This is a strategy that aligns closely to available literature on introduction of innovation (Anil et al., 2015a);
- providing newsletters articles about OFT in grower group newsletters;
- having an OFT newsletter;
- using experts (or champions) to promote and advocate for OFT;
- marketing through established grower information sharing resources such as 'Groundcover';
- creating links within grower group web sites and with GRDC web applications;
- the use of social media;
- using education and training as a way to market OFT; and
- presentation at conferences and Annual General Meetings.

Participant feedback suggested the need to develop a marketing and communication strategy that mapped varied marketing techniques, and the ways in which they could be most effectively implemented across different locations nationally. The message was clearly that any ad hoc approach to reaching target audiences was not likely to be successful – rather the approach needed to be addressed in a structured and planned way. The ways in which research participants viewed these techniques for marketing OFT as ways to effectively support extended awareness and uptake of OFT are captured in the following extracts of interviews.

> *"And even, if you could push it through Twitter and Facebook and have links to like, a like say in 2001 we saw this out in the paddock, it's happening at that stage, like if (grower group named) could quick go onto a database and go back in 2001 we say this happening, link to the online trials database, and then yeah, that actually reaches out to that many more farmer members and that kind of thing, in a way for us to distribute that information is really good" [Interview participant: grower group].*
>
> *"The marketing strategy (say going to field days needs to include a show and tell so that it is simple and easy to use and gets interest going" [Interview participant: GRDC panel].*
>
> *"Need groundcover – a half page article about OFT and the grower group alliance – an important resource for expansion and development" [Interview participant: GRDC panel member].*
>
> *"Groundcover is the best way to market the resource. GRDC social media. Use social media" [Interview participant: GRDC panel member].*
>
> *"If you market it to our advisors then that is a good way to get the grower interested – so I guess make sure you use the middle man as a way to get it known about" [Interview participant: grower].*
>
> *"The agronomist is often the interpreter as well, so they might go to a field day and actually see it. So part of the system may be to prompt them that there is a piece of work going on in that space. As opposed to you know, doing the analysis all online. I don't think you're going to replace one with the other, there will still be that visual inspection and questioning. I mean at the moment there's not enough of OFT even to put questioning on there because the resource to actually respond to it because it's legacy information doesn't necessarily exist" [Interview participant: GRDC staff].*

For these participants, the need is not simply about marketing, but about marketing within the context of knowledge building and the use of field experts as part of the marketing and subsequent engagement process. Approaches such as demonstrations, newsletters and attendance at field days are all valuable for awareness building, but these are not sufficiently powerful to achieve high levels of uptake.

The key message that emerges through analysis of this feedback is that participants identified marketing as a complex process – one that needs to occur within the context of additional supports. Although the terminology is not used, the conceptualisation that can be drawn from the statements of interview participants is that, in addition to publicity, strategies such as education and training about the use of OFT, and innovation championing of the resource are an important part of any marketing strategy. The ways that these can be integrated into marketing strategies, and why they are an important element of marketing for increased awareness and uptake of OFT, are detailed in sub-sections 4.4.3 and 4.4.4 of this report.

Before examining these particular issues, it is important to clarify that although the suggestions of research participants on potential ways to build awareness of OFT and support uptake have been reported here, this is not an indication that marketing and communication work has not been undertaken previously by the OFT team. Marketing has been identified by the OFT team as an important part of building uptake of OFT and, since the development of OFT, increasing levels of product marketing have occurred. The amount of marketing that has been undertaken has increased in parallel to the expansion of data sets and the growth of the OFT team itself.

Importantly, many of the strategies currently used by the OFT team align closely with the marketing suggestions made by interview participants. The close alignment between what participants feel needs to be done from a marketing perspective and what is actually done validates the level of insight within the OFT team on what is most likely to be successful with key stakeholders in the grains space. This alignment between what is being done, and research participant suggestions for change needs to be overtly acknowledged within this report.

To fully illustrate the extent of the alignment between current actions and suggestions for change, Table 6 is presented. This table captures the range of activities undertaken by the OFT for marketing and communication since project establishment and reinforces the close alignment between sector assessments of what will work, and those of the OFT team

Table 6: Marketing strategies operationalized by OFT team since establishment

Areas for inclusion in a Marketing and Communication strategy	Has already been identified and delivered (to some level) by the OFT team	Was identified during interview as a needed initiative
Communication and Marketing Plan	✓ A draft Communication Plan was developed in 2014 by the OFT team – has not, to this point, been endorsed by GRDC	✓
Presentation and demonstration of OFT at field days	✓ A range of activities have been undertaken by the OFT team – including attendance at SFS field days and provision of information pamphlets at field days in WA and Qld, Information summary to be included in attendee information packs	✓
Establish an OFT newsletter	✓ eNewsletter (established late 2014). Currently has 54 recipients	✓
Providing newsletter articles about OFT in grower group newsletter	✓ Have provided articles for inclusion in Liebe Group and Northern Grower alliance newsletters	✓
Using experts (or champions) to promote and advocate for OFT	Some work has been undertaken in this area in terms of funding a .5 position in WA and using domain experts for establishment of OFT however there has not been a targeted program of establishing innovation champions developed within OFT at the point of wave 1 research	✓
Use of a range of media releases to maximize promotion opportunity	✓ External media – media releases and promotion OFT internal news page to highlight project activities, achievements. Total 11 articles from June 2014	Not identified during data collection

Areas for inclusion in a Marketing and Communication strategy	Has already been identified and delivered (to some level) by the OFT team	Was identified during interview as a needed initiative
The use of social media to promote OFT	✓ OFT has Twitter which has 562 followers and has sent 286 tweets since June 2014 You Tube – OFT has own You tube channel with 5 videos available	✓
The presentation at conferences and Annual General Meetings	✓ GRDC updates – stall in Goondiwindi and Ballarat in 2015 Research paper for western region updates Engagement meetings: AgEX, GGA, DAFWA, Wheatbelt NRM, NSW grower group GGA annual forum VGGA meeting VFF conference	✓
Marketing through established grower information sharing resources such as Groundcover	A strategy not yet used by OFT team	✓
Creating links within grower group web sites and with GRDC web applications	✓ Currently working with a range of stakeholders to include links into other websites. OFT included as a widget on the SFS website – an approach which will be expanded into the future	✓
Using education and training as a way to market OFT	Some work has been undertaken in this area in terms of funding a 0.5 FTE position in WA and using domain experts for establishment of OFT however there has not been a targeted program of education and training to build skills and shift marketing away from awareness building and into training and knowledge building with key individuals across the sector	✓

Given the information shown Table 6 and the embedded strategies used by the OFT team for marketing, it is clear that, although some good initial inroads have been made toward addressing marketing needs, some consolidation of existing strategies, and expansion into new approaches to marketing of OFT, is needed. More rigorous and targeted promotion is required to ensure that marketing initiatives reach relevant target audiences. In addition, a stronger reliance on social learning approaches (through education and championing) is needed to

shift marketing from awareness building to knowledge aimed at facilitation of uptake. For this to occur as effectively as possible, it is necessary to develop and document a marketing implementation plan for OFT into the future.

4.4.3 Building potential and connection into the future – the innovation champion

An issue that is integral to effective marketing and, through this, increase levels of uptake, is that of identifying a range of innovation champions for OFT. The use of champions to support integration of innovation has been identified globally as a pivotal success factor across a range of sectors and innovation types (Al Masawi, 2014; Dopson et al., 2002; Ferlie et al., 2001; Straith et al., 2014; Strong & Irani, 2011). It has been proven to provide a mechanism to build trust, support uptake (both conceptually and operationally) and ensure levels of understanding about all aspects of the innovation are maximised.

Importantly, the themes that were dominant in the established literature relating to champions were mirrored in the feedback collected as part of this research project. Research participants consistently reinforced the need for champions - individuals who could be trusted to represent the interests of key stakeholders and support them in working through the more complex aspects of accessing the innovation and applying the information and shared knowledge to the decision-making process.

> *"I know I need to ah, understand the hows and whys before I can be really comfortable to use it I guess. I use my networks and talk about it with people. It is really great when there is someone who is really excited about something and then they get you excited and that helps me a lot. We are here on our own and I do most of the searching for ideas and thinking about how to make things work. If someone I trust says yep for them then it's usually yep for me (this quote refers to an innovation champion although this terminology is not used)" [Interview participant: grower].*

To maximise the effectiveness of innovation champions, and to ensure alignment with the developing and potentially shifting goals of the OFT team over time, the role of the innovation champion should be integrated with the education and marketing elements of staged implementation process. In that way the champion becomes linked seamlessly to the roll out and implementation support of OFT – the trusted expert.

The need for this type of integration has already been identified (and acted upon) by the OFT team, with the funding of a 0.5 FTE position in Western Australia to support implementation at a local level. This approach of identifying individuals locally to work with potential end users' needs to be continued and expanded so that innovation champions become a mechanism through which to market, education and support expansion across the grains space. It is this type of integrated approach to championing a new innovation that has been found to be most effective at the global level (Klerkx et al., 2010; 2012; 2013) for agriculture. Given the importance of trust, networking and localised education (without the use of scientific jargon) to this sector, this type of integration is likely to be pivotal to success.

This approach, in addition to being reflective of best practice in the use of innovation champions, is also reflective of the suggestions made by interview participants for maximising uptake of innovation. While not all participants used the term 'champion' the concepts of using key individuals to lead the move toward adoption of OFT reflects the notion of innovation championing.

> *"If we could build our skill base in how to use OFT for decision making then we are the people that are going out and working with growers and so we could be the people that tell them about it and push (champion) the whole thing. And I guess we could do that with other groups and with consultants and others as well" [Interview participant: grower groups].*

> *"once we get a lot of growers, grower group training materials in there, depending on the subject matter that you're trying to actually improve adoption on it might be as simple as wanting some scans on the system and actually getting the core advocates that conducted the trials to run the training using the*

system as a support tool. And/or using some of the you know, social networking functions that may not exist now but could exist in the system in the future to facilitate an online exchange. You know, who's the champion that is going to advocate the various trials that might make you make that decision to go from a particular practice to another one… the next step is getting those champions on board to actually do some of that analysis potentially. So each trial probably had analysis undertaken because it's on there but have, has the totality of all the projects been considered" [Interview participant: GRDC staff member].

Acknowledging this call for champions, the question was aked: what are the approaches needed to develop this initiative? There are a range of strategies that can be applied to the process of building innovation champions. These include:

- funding individuals to work in local areas (such as is the case with OFT staff in WA);
- identifying key individuals within grower groups to champion OFT, with support given as part of their professional development processes;
- working with individual growers; and
- working with key agricultural consultants.

The approach of working with agricultural consultants has already been a strategy implemented by the OFT team with case study videos contained on the OFT site (on how to use the innovation) delivered by an agricultural consultant. This is a strategy that could be expanded into the future effectively, particularly given the strong and positive relationships already in place with a number of agricultural consultants who have been instrumental in the development of the OFT resource. Finally, building champions within GRDC is also a mechanism that has merit – with existing foundations in place that could be expanded into the future.

This research finding relating to the need for innovation champions highlights that a key future step in this area must be the development of a documented strategy for the identification, support and embedding of innovation champions across a range of locations nationally. This could be included as part of the overall marketing plan as a foundational implementation strategy for enhanced roll out of OFT into the future.

Another foundational implementation area that was identified during data collection was that of the need for education and training around the role and place of OFT in the grains sector.

4.4.4 Building potential into the future – education on how to use the innovation

A key issue identified by research participants, particularly those from within GRDC, the grower groups or those who worked as agricultural consultants, was the issue of using a localised training program to promote and build understanding of OFT. This was another area that was closely aligned to the key messages gained through the literature relating to the need for local delivery, identification (and addressing) of key local issues and the use of social learning techniques using champions, peers and trusted sources (Blackstock et al., 2010; Chatzimichael et al., 2014; Reardon-Smith et al., 2015; Vanclay, 2004).

Suggestions made during data collection relating to building potential and reach through education and training included:

- delivery of workshops at a range of events such as field days, conferences and/or annual general meetings involving the opportunity for 'hands on' use of technology. This approach would require a concept such as a road show where the OFT team (at least in the initial stages) would work to organise local venues with effective computer access and liaise with a group of individuals (interested groups and identified champions) to address a pre identified local issue. The building of pre-workshop knowledge about key issues could occur through either capturing issues online or through OFT domain experts working with key local experts to:

- identify, on a location-by-location basis, key issues of relevance;
- work through problem solving strategies using localised issues as a point of analysis. The techniques used would then be operationalised through the mechanism of the workshop. The emphasis in this approach would be on application of solutions using both local and national trials to ensure that the value of legacy and comparability were consistently showcased as unique attributes of OFT.

The potential of this type of approach is captured in statements such as:

> *"it may be you think about well maybe I'll pick off two or three farming groups that would be interested in trying this approach of answering the questions people have got, and we'll support that with some resource to help them host that. Part of that payoff is they've got to use the on-farm tools as sort of you know, I suppose part of that process. So you're almost, buying their interest to start with, but it might be a useful way of you know if you're think of extension that might be a far better way to give them a go, to a couple of grand or something, 15 hundred bucks, a thousand bucks to host something, invite their consultants along and amongst other things, and use that answer the questions the consultants have got, so the consultants have um, those questions asked beforehand [interview participant: consultant agronomist]"*

- Working to identify key issues (perhaps linked to 'Hot Topics' already on OFT) and then developing interactive case studies which will take end users through the process of using OFT to build knowledge for informed decision making.

  It should be noted with this suggestion that only a very small number of interview participants indicated that they had used the video case studies already available on OFT. None of those who responded to the survey were even aware that the videos had been included on the OFT site, and only seven out of the 37 (19%) people involved in the interview were aware of the video component of OFT. This means one of three things: (1) more promotion of the video component of OFT is needed to maximise use of this resource; (2) video case studies are not an effective engagement tool for the end users in this sector; or (3) people did not know about the resource but, even if they did, would not use this as a medium through which to build knowledge. Clarification of which of these three issues was the cause of low levels of access of existing OFT resources was not one of the variables tested for this study, so it is not possible to make an assessment relating to why this occurred. However, the results do identify the need to consider effectiveness should this technique be adopted as a mechanism for end user training.

- Establishing chat rooms for peers and domain experts to ask and answer questions.

- Developing online resources for end users to access. This is another area that would need to be approached with caution given that the literature has shown that this type of formalised model of education and training has not been very successful in the past (Baumgart-Getz et al., 2012; Reardon-Smith et al., 2015). However, if this approach was supplemented with social learning techniques such as online chatrooms, mentoring or feedback loops or with face to face contact, as needed, it may be an effective strategy for increased access and uptake of OFT.

A combination of chat rooms and online feedback were viewed as a potential approach by a small number of research participants, with this view captured in statements such as:

> *"an SJ [a particular personality type] tends to validate ideas so that's why I'm supportive of crowd sourcing because they want to hear what others think of it. Um, so if you look at some of the things here, SJ temperament describes a culture that's less likely to evolve new ideas and will resist change, decision makers with SJ temperament will need to be convinced of the need to change. Now, does OFT do that? It doesn't. I mean, at the end of the day it's still up to the individual. And they'll do that convincing in their own mind but if you've got a crowd sourcing function where you've got people that are actually doing that, that might actually help them. Um, they tend to define themselves by their experience and have a deeper investment in its value unless there is a clear, desperate need to change they prefer to stick to*

set procedure, established routines and historic precedents that guide them. And they prefer practical concrete problems rather than theoretical or abstract concepts" [Interview participant: GRDC staff].

In this list of options collected and collated through the interview process, the approach most closely aligned to what available literature has identified as an approach most likely to work in the agricultural sector is the delivery of workshops addressing localised issues. This approach would allow for a social learning approach to be taken, for key local priorities to be addressed using both local and national data sets, while building champions and supporting the integration of their role into the local area (Blackstock et al., 2010; Chatzimichael et al., 2014; Klerx et al., 2013; Reardon-Smith et al., 2015; Vanclay, 2004).

The following brief case study sets out an example of how one research participant felt the workshop process might be applied for building interest in OFT and helping potential users to understand what could be gained through use of the resource.

Case studying a workshop approach in using OFT

Approach 1

"Give people the opportunity to come to you with a question and then step people through that. So whether you've got a you know a booth or an actual session and you've got 5 or 6 computers and people there at an event and people can come up to you and say look I want to, can you find me all the information about such and such and demonstrate and use it with them.

They say 'oh geez that was easy, I could go home and do that'.

So for me it's got to be question driven. So, otherwise if it's just an awareness thing of this is what you can do it doesn't have the same resonance so that if they've got a question, a specific question of their own, 'Gee I want to know about response to lime' in you know, 'what's there? what can I find?'. And then you can demonstrate some of the power of it well in your patch this is what you can find, there's only two trials but if we search a bit wider to similar rainfall environments in say New South Wales and South Australia here's another 6 trials. Um, if we look at all across Australia here's 20 trials. I think then you can demonstrate the power of what it does. But to me it's got to be driven by you know those questions. The questions people have got and so you can either mock them up or I think you've got to think of clever ways of engaging people and helping them to answer a question they've got" [Interview participant: agricultural consultant].

Approach 2:

"Use it as a validation tool in particular to make decisions. Um, and over time as more, more data becomes available that I think you will get a much richer experience. That will provide challenges for us in terms of making the data easy to find um, you know there's a large volume of trials on there and It's a matter of um, I think having a, someone with expertise, like a subject matter expert actually, not only critiquing the material um, you know technologies great in that it can do a lot for us in terms of filtering but at the end of the day there might be specific queries that come in that require a human to still think about the end product. And I suspect that the tool will deliver that. So I think in terms of understanding, you know not just analytics of what people are looking for but the types of questions that they're asking, will be really important going forward" [Interview participant: GRDC staff member].

Regardless of the approach adopted for education and training for increasing access and uptake of OFT, the research process has identified that, as part of overall marketing of the resource, an education and training plan will need to be developed as a matter of priority, and as an integrated component of the next stage of implementation/roll out of OFT.

The final area to be considered in regard to maximising uptake of OFT and sustainability of the resource into the future, relates to links between OFT and the goals and requirements of the major funding body, GRDC.

4.4.5 GRDC, contractual obligations and building future potential

The issue of the relationship between OFT sustainability and the ways in which GRDC, as a funding body, might contribute to sustainability was not a focus of this current study. There were no questions relating to this issue posed in either the interview or the survey schedules, and it was not a target data collection area for researchers involved in the interview process.

Despite this, the issue of the relationship between OFT sustainability and GRDC funding processes was raised by 24% of the overall interview participant pool (nine out of 37 participants). Although this does not represent a majority of interview participants, it is a significant number to be commenting on an issue that was not part of a structured and replicated data collection process. It is also significant that, of those nine interview participants who raised the issue, five were from either the GRDC panels or were GRDC staff. These five participants represent 45% of the overall pool from these two groupings.

The nature of the issues raised by these participants was closely linked to funding and regulation. The specific points made were:

- the need to ensure that, given the current level of development of OFT, the potential for ongoing roll out, and inclusion of all relevant data sets, be maximised. This required a commitment of adequate programmatic funding for project sustainability;

- the importance of expansion of the project – both to capture all GRDC funded on-farm trials but also to explore other relevant (locally and nationally externally funded) trials that have no other ready mechanism for open access. The inclusion of this type of data was viewed as an important part of the landscape of farm trial data sets of relevance to informing practice and building sector knowledge;

- the need to explore the option of the inclusion of OFT as part of the contractual obligations under the Regional Cropping Solutions Network (RCSN) contract process. The view was that this would provide a mechanism to ensure that OFT was a foundational resource for the sector rather than a resource that was used by a small number of end users – a situation which was considered as being likely to diminish the potential of OFT to inform sector practice and decision making. This approach was also considered a way to optimise the work that has been done already in the area of farm trials – value adding and enhancing an existing resource and maximising the reach of expended resources across the sector; and

- the potential for joint marketing arrangements to maximise reach and priority given to OFT within the context of GRDC resourcing.

A cross section of the feedback that captures these views is included below for reader consideration.

> *"It [GRDC] must put in sufficient funds to keep it going. It needs to become (a situation of) – if you are not putting your stuff in there – you are not doing the right thing" [Interview participant: GRDC panel member].*

"The GRDC needs to get in there – help to get this great resource out there. The concept is fabulous and I have been telling GRDC that they need to do something to get the information out there so farmers have easy access and some training on how to use it all. It is a really great resource" [Interview participant: GRDC panel member].

"OFT needs to become the central pool – this needs to become an embedded requirement to utilize OFT. Otherwise it runs a risk of being a side resource" [Interview participant Grain Grower Group].

"contracts need to be written so that data input is required and then the purpose can grow and expand and it has real capacity to be more into the longer term: [Interview participant: GRDC staff].

"Momentum is critical so it must be picked up and grown as a matter of urgency. Need to make entry easy. Needs to get a momentum of its own so the awareness phase is critical for longevity of OFT. [part of that is that it] … needs to be sanctioned by GRDC and if there is a resourcing issue then this needs to be addressed and picked up by GRDC. This is something critical for going forward to maximise reach and capacity" [Interview participant: GRDC panel member].

As a consequence of this feedback, OFT team members have begun to explore the role of GRDC in supporting sustainability of OFT into the longer term. This process occurred outside the process of data collection and analysis that was undertaken for this research study but has been included here given that the issue was raised during interviews.

Initial discussions between CeRDI and GRDC have highlighted that this is an area that has potential for development. Some foundational work needs to be undertaken to address issues relating to marketing, education, maximising quality assessments and trust in the data, as identified in this report. In addition, there are a range of procedural questions relating to the types of data that needs to be included and clarification of data entry requirements in relation to pre- and post-trial information, in order to maximise uniformity across data sets.

It is an issue that should be progressed and monitored in parallel with the implementation of the recommendations provided in the following section of this report.

4.4.6 Findings summary: examining capacity into the future and a focus for change

A range of issues relating to development and enhancement of OFT into the future were explored in this last section of the research report. A part of this exploration, a number of key findings were drawn and are presented in summary below.

- There needs to be a reconceptualisation of methods for the roll out of OFT. During the initial stages of roll out since establishment the model applied has been linear. This has involved the development of OFT and an associated assumption that ready availability would be the driver for subsequent uptake. As this was a resource which had been sought by the sector there was a level of assumption that, as a natural transition, end users would seek out and apply the resource to their toolkit of decision making resources. The roll out through the mechanism of grower groups was considered to be the most effective approach as, given that local data was being used at each site, this would facilitate ready marketing and engagement. Feedback from the research process highlighted that, while not incorrect, this approach needed strengthening and expansion. There was a need to implement a range of engagement strategies which would maximise uptake into the longer term. These strategies needed to be overlaid with a hierarchy of uptake – i.e. targeting first agricultural consultants and grower groups and then, through successful engagement of these stakeholders, other potential users. This approach was viewed as most likely to result in an extended uptake involving growers themselves.

This was not an exclusive model (in that there remain a number of growers who do not access these resources and therefore cannot benefit from a strategy that targets these groups over others); however, it needs to be the dominant model. Targeting these groups as the first step in a staged roll out was viewed as likely to be the most effective strategy for enhanced access and level of uptake.

- The need for ongoing and extended marketing of OFT was identified by the majority of those involved in data collection. Many of the strategies outlined by research participants mirrored much of the marketing work already undertaken by the OFT team including:
    - presentations and demonstration of OFT at field days;
    - providing newsletters articles about OFT in grower group newsletters
    - having an OFT newsletter;
    - using experts (or champions) to promote and advocate for OFT;
    - marketing through established grower information sharing resources such as Groundcover;
    - creating links within grower group web sites and with GRDC web applications;
    - the use of social media;
    - using education and training as a way to market OFT; and
    - presentations at conferences and Annual General Meetings.

  The fact that these strategies were emphasised as critical for ongoing marketing of OFT by those involved at interview highlights that, although the OFT team strategies for marketing are appropriate for the sector, they are not reaching all relevant stakeholders. There needs to be both an expansion of marketing activity and a structured marketing implementation plan to ensure that relevant areas for marketing focus are identified and targeted into the future.

- It is critical to work toward the establishment of a range of innovation champions. This is a role that should be integrated into the marketing plan developed for enhanced uptake and longer term sustainability of OFT In order to maximise the success of introducing innovation champions, their introduction needs to be bounded by the following defining characteristics of the champion themselves in that they need to be:
    - locally based;
    - well connected across a number of groups and organisations;
    - trusted and known within the grains sector in that location. This assumes that this individual is part of a range of local networks;
    - familiar with OFT and able to champion key attributed of the innovation; and
    - willing to delivery local education and be involved in OFT marketing processes.

  Remuneration for this role could take a number of forms. The role could be a paid one as part of the OFT team, it could be structured as a professional development activity or it could simply involve targeting key individuals with a commitment to the introduction of decision support. Regardless of the approach taken, it is an approach that needs to be applied nationally – mirroring some of the strategies already inn pace with the OFT team through the use of paid staff in remote locations and the use of domain experts in resource development.

- The development of education and training initiatives for OFT. This can involve a range of approaches including:
    - delivery of workshops at a range of events. This approach must include the opportunity for practical application and the solving of priority issues for the local context;
    - developing interactive case studies based on identified hot topics;
    - establishing chat rooms for peers and domain experts; and
    - developing online resources

There are strengths and shortfalls around each of these approaches and it may be a mixed model will need to be implemented - that the solution is location specific, dependent on identified need.

An education and training strategy will need to be developed in conjunction with the marketing plan to address this need for education and training in a coordinated manner across all states.

- The inclusion of OFT as part of contractual obligations between GRDC and grower groups through the RCSN. There was a consistent message from a group of research participants that issues of funding, integration, marketing and sustainability need to be addressed in a coordinated way in order to maximise the reach of OFT and ensure that it becomes a central resource for the grains sector. Participants who commented on this issue assessed that proactive strategies to ensure that OFT achieves its full potential as a valuable sector resource requires the issue of programmatic sustainability be explored with GRDC into the longer term

The key element relevant to Level 1 (Primary Impact) assessment for this section is 'potential for further development'. It has already been rated in the previous sub-section of this report (in the summary findings for Section 4.3); however, data of relevance to informing the rating of this element was also examined in this current sub-section. The rating is therefore listed below (Table 7) to highlight the importance of using targeted developments (such as marketing, education, programmatic funding and champions) into the future to strengthen the reach of OFT and enable the attainment of a higher order rating for this element across Levels 2 and 3 impacts into the future.

Table 7: Ratings for elements tested for impact in Section 4.4

Area reviewed for Impact Assessment	Rating given	Rationale
Potential for further development	2.5 Assessed as moving toward the higher end of the ratings spectrum	The information provided through interview data highlighted a range of unique capabilities that indicate a forward movement toward positive OFT development. This meets the requirements for Level 1 and it was identified that there was an overt and consistent message provided that participants could identify the potential of OFT (either currently or in the future) to be used as a resource with capacity to enhance and support future development initiatives within the sector and/or for research and data discovery and a framework for building characteristics and capabilities likely to be beneficial to the grain sector into the longer term. A full rating of 3 was not given as the level of development remains high for this area. The extent of implementation of these targeted change areas will influence ratings and attainment potential for level 2 and level 3 impact assessments to occur in subsequent waves of research

Section 5 Study conclusions and recommendations

The findings from this first wave of research into the early stages of implementation of OFT has provided a number of important insights into the value attributed to OFT as a technological innovation. It has also provided insights into areas that need to be addressed through a range of recommendations to maximise the reach and sustainability of OFT as a tool for informed decision making at the local and national levels.

5.1 Study conclusions

The data collection process has enabled a range of findings to be mapped against the research questions set for the study; a mapping that provides good foundational data for building research insights of relevance to OFT. This knowledge, gained through Wave 1 of the extended timeframe study will be reviewed as the study moves into subsequent waves of data collection, allowing for the measurement of change and the consolidation and validation of learning over time. As part of this mapping, a summary of the key findings, and their alignment to the research questions, are provided in Table 8.

Table 8: Aligning research questions with findings of the Wave 1 study

Research question	Findings providing insights into the research question
Question 1: What strategies in implementation of Online Farm Trials have worked most effectively to support and facilitate data access to the maximum numbers of potential end users?	✓ Working with local groups and individuals ✓ The use of localized agronomic data ✓ The delivery of initial education and training (non formalised). It was also identified that this will need to be extended – quantity, structure and number of locations ✓ The use of innovation champions such as expert agronomists who have been involved in early stage OFT. This will need to be expanded – number of champions and range of locations ✓ Good feedback loops with OFT team
Question 2: What approaches applied during the eResearch relationship were found to maximise stakeholder input to the knowledge building process?	✓ Building a strong relationship with those providing the data and ensuring the capacity for ongoing positive feedback and support ✓ Recognition of the importance of localized content ✓ Ensuring high quality of data ✓ Ensuring high levels of trust in the data ✓ Maximising usability ✓ Good participant experiences
Question 3: What have been the key impacts of Online Farm Trials for a range of key stakeholders, including growers, farming groups, researchers and agronomists?	✓ Breaking down knowledge silos to shift the paradigm of control around data ✓ Enabling access to legacy for tracking knowledge and allowing for comparability of knowledge ✓ Shifting the locus of control in terms of informing decision making ✓ Through decreased duplication of trial research ✓ Enhancing the capacity for more informed decision making – there are very early indicators of the potential for economic benefit through building capacity for informed decision making

Research question	Findings providing insights into the research question
Question 4: How have Online Farm Trials effectively captured data that can be used to build evidence based knowledge repositories to maximise access and minimise research duplication over the longer term?	✓ Through inclusion of previously siloed data sets ✓ Through the building of research ready data sets which, through legacy and comparability potential increase the ability to identify hidden data – trends and data discovery ✓ The OFT becoming a mechanism through which to improve data accuracy and research potential ✓ Through capacity for legacy and for site and trial type comparability – as well as through the capturing of a history of number and type of trials in readily accessible form
Question 5: In what ways does open data access, as provided through the tools and mechanisms of eResearch, impact on decision making and facilitate practice change?	✓ Breaking down knowledge silos to shift the paradigm of control around data ✓ Through building a resource that provided a mechanism for informing decision making ✓ Through multiple data sets and interoperability as a central feature of OFT ✓ Through increased capacity to meet diverse information needs ✓ Through potential for productivity savings through efficiency gains and subsequently greater levels of flexibility across the sector

In addition to informing the research process specific to OFT, these findings also provide valuable discoveries that, while specific to OFT, also inform and build the knowledge base of relevance to the CeRDI multi bounded system design study (refer to Section 3 of this report). This larger study aims to measure, through an overarching generalisability and replication framework, an evidence base of relevance to knowledge building on the impact of technological innovation initiatives developed and delivered through CeRDI. These research findings are an important part of that process.

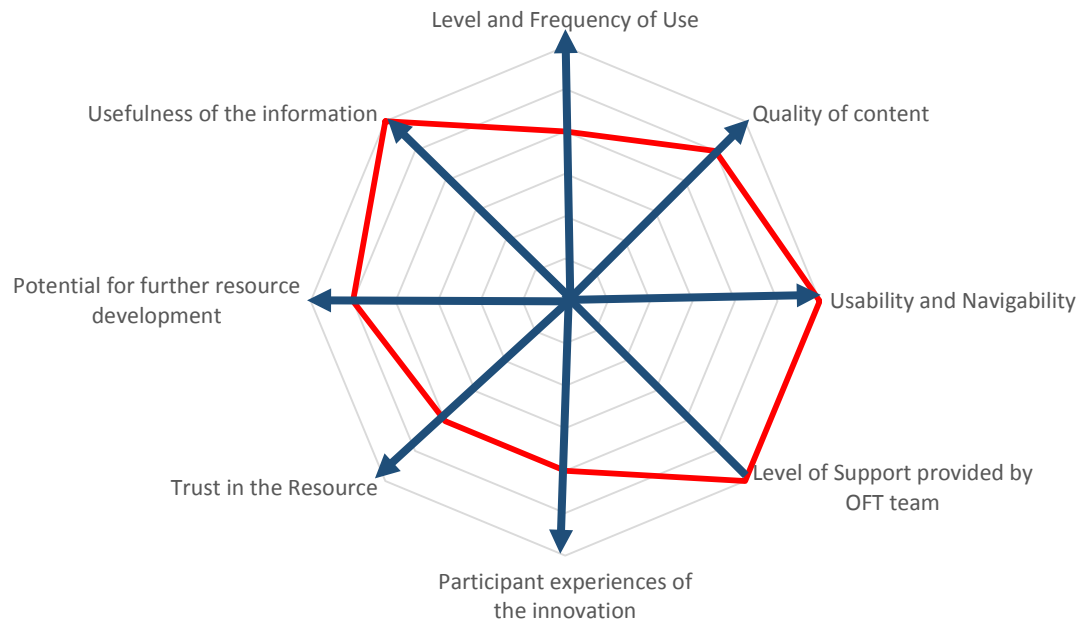
In terms of the attainment of Level 1 (*Primary Impact*), the collection and rating of data throughout the study has enabled the degree of attainment of Level 1 impact to be mapped visually. This occurs through the consolidation of the ratings gained across the eight elements being measured over the data collection and analysis process (each of which was detailed in the summary provided at the end of each section of this report).The findings are very positive and show that, against the ratings established for Level 1 impact, OFT has made a significant initial impact – noting that there are a number of areas for ongoing development into the future. The collation of these rated outcomes across all eight elements is provided in Table 9.

Table 9: Ratings attainment for OFT Level 1 (*Primary Level*) impact

Factor examined through analysis of collected data	Rating within the scope of Level 1 (Primary Impact) of the three levels of impact
Level and frequency of use	2
Quality of content	2.5
Usability and navigability	3
Level of support provided by OFT team	3
Participant experiences of the innovation	2
Trust in the resource	2
Potential for further resource development	2.5
Usefulness of the information	3

When mapped visually, the results provide a very clear picture of attainment of a Level 1 (*Primary Impact*) during the early stages of implementation of OFT. This is provided in Figure 14 – and indicates a strong outcome across the majority of elements of relevance.

Figure 14: Assessing impact at Level 1



In conclusion, this report has focused on specific learning drawn from the collected and analysed data pools; however it is noted that there are also overarching themes that can be drawn from study learnings. These themes relate to the impact of eResearch on practice decision making, knowledge building and information sharing. Interestingly, these emergent themes from Wave 1 OFT research mirror themes that were identified in wave 1 data collection for both VVG and HUL – the first two studies undertaken as part of the CeRDI MBSD. This outcome a very initial indication of commonalities across the CeRDI technological innovation process and the role it plays in supporting and shifting decision making and, potentially, strengthening practice into the longer term.

The key themes able to be drawn from all the data collected and analysed for this study are as follows.

Theme 1: Positive shifts in OFT usage trends are facilitated by high levels of ease of accessibility and confidence in data quality. Upward trends in frequency of use and repeat visitation rates are dependent on these factors and the way in which they enable the resource to be viewed as a viable and sustainable mechanism for information access.

Theme 2: The dominant characteristic of OFT, particularly in relation to access and data reliability, is that it is emerging as instrumental in facilitating the breakdown in knowledge silos. This characteristic, if developed to maximum potential, can shift the dominant paradigm from one of knowledge controlled by individual grower groups to one of knowledge sharing and increased accessibility at the local, state and national level for all end users. The nature of OFT allows for a shift that is a seamless.

Theme 3: Positive experiences for end users in accessing OFT can, over time, shift how they interact with the resource – changing the relationship from one in which the end user accesses the portal infrequently to a more complex interaction which includes end user information input, advice seeking and participation in the process of building/enhancing knowledge.

Theme 4: The provision of diverse clusters of complex information through the mechanism of multiple data sets increases, in an upward trajectory, the relevance and applicability of data and consequently provides end users with a resource to strengthen planning and facilitate informed decision making.

Theme 5: Single access, multiple data set web portals enhance capacity across community and industry in terms of the provision of:

- timely, informed and accurate responses to those seeking information/answers to queries;
- improved mechanisms for making informed decisions - maximising the potential for good outcomes and positive developments across a field of study; and
- increased potential for collaboration and connection through shared local and national data sets.

Theme 6: The provision of multiple data sets with a single point of access, and the facility of interoperability, establishes a unique opportunity to collate, cross reference and consolidate data that has historically been hidden. This shift establishes a new foundation in accessing research ready data sets and a new capacity for achieving research discoveries.

Theme 7: Technological innovation allows for information access and sector engagement capacities that are not available through more traditional forms of information sharing. This is a notable advance however the introduction of new technology needs to be carefully managed. Before adding more features or datasets it is important, for maximum success capacity, to ensure there is programmatic support to maintain and enhance the usability and capacity of the resource.

Theme 8: Sustainability of technological innovations beyond seed funding requires targeted marketing and a capacity to provide a solid body of evidence on the successes of the innovation and the benefit it provides to the community and the industry for which the technology has the greatest relevance.

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These are significant themes and consolidate existing knowledge around the value of this type of resource for the grains sector. The final statement for this study should always rest with those whose input made the building of research knowledge possible – the end user.

> *"… it really has come together in terms of facilitating information exchange with our partners, in the first instance being grower groups. Um, it's probably in it's infancy in terms of the collection of datasets, and because we are dealing with an unknown quantum of trial information it also poses a lot of challenges as to how many, how many projects, how many programs are actually likely to be facilitated within the system and what that means from a user perspective – but a great start" [Interview participant: GRDC staff].*

> *"OFT finally provides a way to move away from the supply side push to a demand side request – about time we got to this point" [Interview participant: GRDC panel member].*

5.2 Study recommendations

In response to the findings drawn from the data collected and analysed for this study, the following series of recommendations have been made.

Recommendation 1:

That the OFT team target the provision of additional implementation support to grower groups in Queensland and New South Wales. This target is needed to maximise involvement from these areas in the OFT initiative. Queensland and New South Wales are currently under represented nationally in the number of farm trials uploaded, and in the level of participant feedback to the research process. The provision of focused support is likely to enhance future participation in OFT research and, importantly, in achieving a more nationally balanced upload of full trial reports and full trial results.

Recommendation 2:

That negotiations occur with research scientists at a variety of key organisations, including CSIRO, GRDC and CeRDI, to establish research planning collaborations. These collaborations will provide the means through which to establish, wherever possible, uniform farm trials development standards. This work should include the identification of a range of quality enhancement strategies for farm trial data into the future. These could include the introduction and inclusion of pre- and post-trial variables such as soil, growing conditions and sowing methods to maximise knowledge in terms of data variability across trials and enhance comparability for research application of farm trials data.

Recommendation 3:

That the OFT team, in consultation with targeted domain experts, work on the development of an inventory of practical techniques aimed at combining legacy data, comparison capacity and evidence held within OFT to shift the potential of OFT from a repository to a live decision making support tool. Although the nature of this inventory is yet to be determined it may include:

- building links to other repositories of evidence;
- targeting specific priority issues in the sector as pilots for ongoing exploration;
- the development of OFT research application toolkits; and/or
- the use of 'flagship' trials to map the data to research discovery process.

The overall aim of this approach is to develop use friendly options for the practical use of OFT in decision making.

Recommendation 4:

That work be undertaken with domain experts in the measurement of economic cost/benefit programmatic analysis to identify ways to facilitate the incorporation of economic modelling into subsequent waves of data collection for OFT research. Once these have been developed, that work be undertaken in conjunction with the OFT team to ensure that potential economic impact of OFT is captured over subsequent waves of research for this study

Recommendation 5:

That the current linear model of establishment, implementation and uptake that has, in the main, characterised the early implementation phase of OFT be redesigned to reflect a more staged approach. The revised model should include a range of uptake enhancement strategies relating to marketing, education, championing and the role of contractual obligation. While recommendations specific to each of these will be detailed in the following recommendations (Recommendations 6–10, an overt transition to a staged and less linear notion of uptake needs

to be discussed and implemented as part of OFT team forward planning to maximise the capacity for longer term sustainability of OFT.

Recommendation 6:

That a detailed marketing plan be developed for OFT. This plan should adopt a holistic approach to incorporate documentation of the strategies identified in Recommendations 7 and 8 and providing integrated links between and across strategies in order to capture implementation priorities, timelines and modes of delivery. The development of this plan aims to ensure that there is a structured, timed and mapped marketing strategy in place to align with current and future roll out targets for OFT.

Recommendation 7:

That the OFT team, in conjunction with consultation involving GRDC, domain experts and grower groups, detail a process for the identification of innovation champions. This process should include the overt identification of the key characteristics needed for innovation champions and suggestions of potential early innovators to be involved in this program start up. The characteristics that need to be included in innovation champion selection should include: those with domain expertise; having good local and national networks; holding strong professional links across the community; an individual assessed as being a trusted expert in the target community; as well as, having an understanding of OFT and how to maximise the potential of OFT for use in decision making.

Recommendation 8:

That the role of the innovation champion(s) be expanded to encompass active participation in education and project development. This approach will ensure that the process of information sharing and knowledge transfer is holistic, succinct and representative of the potential and place of OFT in the grains sector. Implementation of this recommendation will require champions to work closely with the OFT team, with grower groups and with identified key stakeholders in the sector. As part of implementation of this recommendation pursuing options for funding of this level of integrated involvement in project roll out need to be explored.

Recommendation 9:

That an education and training implementation plan and schedule be developed and linked to the overall marketing plan for OFT. This should occur as a matter of priority and should be an integrated component of the next stage of implementation/roll out of OFT. The overall focus of this plan should be on maximising training and development approaches and minimising demonstration as the dominant approach to seeking end user engagement.

Recommendation 10:

That the potential for the inclusion of a mandated requirement to upload farm trials data onto OFT be discussed with GRDC. This approach would mean that OFT would become part of the compliance obligations of grower groups nationally, and is a shift that was identified as needing to be explored during the research process. This approach provides a mechanism to maximise viability and usability of trials data for research, to enhance sustainability into the longer term, and to support uniform industry standards relating to on-farm trials.

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Appendices

Appendix 1 Online survey

Online Farm Trials web portal survey

The Online Farm Trials (OFT) web portal has been developed by the Centre for eResearch and Digital Innovation (CeRDI) at Federation University Australia and funded by the Grains Research and Development Corporation (GRDC) as a resource for grain growers, agronomists, researchers, GRDC staff and government representatives to better respond to challenges associated with climate and natural resources through access to current and past grains industry research data using new technologies.

Dr Peter Dahlhaus, together with Dr Angela Murphy, Dr Helen Thompson, Robert Milne, Xenon Ellis and Jennifer Corbett, is undertaking research into the OFT web portal and seeks to explore factors relating to project implementation and development; knowledge building, behaviour change and informed decision making; the impact of online trials on decision making and practice change; farm development and environmental management processes; and enterprise enhancement and intergenerational change. The results of this research will provide important insights into the application and functionality of the OFT web portal, and will also be used by the project team to prepare academic journal articles and conference papers to inform national and international knowledge. The collated data may also be shared via a report to the project partners and funder.

As an individual who has been involved in an OFT implementation site we invite you to participate by spending approximately 15 minutes completing this survey which will ask questions about your usage and access of the OFT web portal and the associated benefits and limitations you have encountered when implementing OFT into your practices. Even if you have not used the OFT web portal or are unaware of it, you are able to participate and register this fact.

For further details about this research please contact research coordinator Dr Angela Murphy on (03) 5327 6198.

This project received approval from Federation University Australia's Human Research Ethics Committee (Approval number: A15-086).

1. Which grower group are you involved with? (Check any that apply)

☐ Birchip Cropping Group
☐ *Central West Farming Systems*
☐ Eyre Peninsula Agricultural Research Foundation
☐ International Plant Nutrition Institute
☐ Liebe Group
☐ Lower Eyre Agricultural Development Association
☐ Northern Grower Alliance
☐ Regional Cropping Solutions Network (WA)
☐ Riverine Plains
☐ Southern Farming Systems
☐ Other: _____

2. Could you please provide your postcode?

_____

3. Could you please indicate your age range?

18 - 25	26 - 35	36 - 45	46 - 55	56 - 65	65 - 75	75+
☐	☐	☐	☐	☐	☐	☐

4. Which of the following categories best describes you? (Check any that apply)

☐ Grower - Landholder
☐ Grower - Share farmer
☐ Grower - Contractor/employee
☐ Agronomist
☐ Researcher
☐ Grower group staff member
☐ GRDC panel member
☐ Other: _____

5. Have you accessed the OFT web portal?

☐ Yes ☐ No

If yes, go to question 7.

6. Why haven't you accessed the OFT web portal? (Check any that apply)

☐ Didn't know about it
☐ Didn't have internet access
☐ Not confident with the technology
☐ Not relevant to my farm enterprise
☐ Not relevant to my business/research activity
☐ Too busy
☐ Not interested
☐ Other: _____

Go to question 32.

7. Which information on the OFT web portal have you accessed: (Check any that apply)

Trial Explorer
☐ Method/treatment
☐ Trial results
☐ Soil conditions
☐ Climate
☐ Trial reports
☐ Resources provided through links/attachments

Report Library
☐ Trial reports
☐ Links to contributing grower groups
☐ Trial projects

8. Please estimate how often you access the OFT web portal:

Daily	A few times a week	Once a week	A few times a month	Once a month	Less than once a month	Never
☐	☐	☐	☐	☐	☐	☐

9. How many times have you visited the OFT web portal since becoming aware of it?

1 - 5 times	6 - 15 times	16 - 25 times	26 - 40 times	41 - 60 times	More than 60
☐	☐	☐	☐	☐	☐

10. Did you find the OFT web portal easy to use?

☐ Yes ☐ No

11. During your visit to the OFT web portal, please rate how easy it was to find the information you were looking for?

Very difficult (1)	(2)	Neutral (3)	(4)	Very easy (5)
☐	☐	☐	☐	☐

12. Please rate the overall usefulness of the following elements of the OFT web portal:

	Not at all useful (1)	(2)	Neutral (3)	(4)	Very useful (5)
Information contained in the Trial Explorer	☐	☐	☐	☐	☐
Information contained in the Report Library	☐	☐	☐	☐	☐
Information contained in the Trial Browser	☐	☐	☐	☐	☐

13. Please rate the usefulness of the following specific features of the OFT web portal:

	Not useful (1)	(2)	Neutral (3)	(4)	V.useful (5)
Search functionality for finding specific information	☐	☐	☐	☐	☐
Filter tools	☐	☐	☐	☐	☐
Access to original trial reports	☐	☐	☐	☐	☐
Capacity to export data	☐	☐	☐	☐	☐
Soil information and classification	☐	☐	☐	☐	☐
Climate data	☐	☐	☐	☐	☐
Map search function	☐	☐	☐	☐	☐
Comparison of variability within and between years	☐	☐	☐	☐	☐
Trial summaries	☐	☐	☐	☐	☐
Original full trial report	☐	☐	☐	☐	☐
Sowing and harvesting details	☐	☐	☐	☐	☐
Treatment details	☐	☐	☐	☐	☐

	Not useful (1)	(2)	Neutral (3)	(4)	V.useful (5)
Providing capacity for historical comparison of trials (legacy data)	☐	☐	☐	☐	☐
Access to GRDC linked content	☐	☐	☐	☐	☐

14. Do you trust the data contained on the OFT web portal?

☐ Yes ☐ No ☐ Sometimes

15. Please provide reasons for your response.

_____
_

16. Was the quality of the data on the OFT web portal useful for your needs?

☐ Yes ☐ No ☐ Sometimes

7. Please rate the overall quality of the data that you accessed through the OFT web portal:

	Low quality (1)	(2)	Medium quality (3)	(4)	High quality (5)
Information contained in the Trial Explorer	☐	☐	☐	☐	☐
Information contained in the Report Library	☐	☐	☐	☐	☐
Information contained in the Trial Browser	☐	☐	☐	☐	☐

18. Please rate the quality of content for the following elements of the OFT web portal:

	Poor (1)	(2)	Neutral (3)	(4)	Excellent (5)	Unsure
Method/treatment	☐	☐	☐	☐	☐	☐
Trial results	☐	☐	☐	☐	☐	☐
Soil conditions	☐	☐	☐	☐	☐	☐
Climate	☐	☐	☐	☐	☐	☐
Resources through the Report Library	☐	☐	☐	☐	☐	☐
GRDC Final Reports	☐	☐	☐	☐	☐	☐

19. What are your reasons for accessing the OFT web portal: (Check any that apply)

☐ To inform farm planning decisions
☐ To check for legacy data (what trials have already been undertaken, trends and past data)
☐ To support business case for farm decisions
☐ In your role as a consultant agronomist
☐ To inform GRDC decisions
☐ To inform grower group planning decisions
☐ To resolve and/or inform decisions in an intergenerational family farm enterprise
☐ To resolve and/or inform decisions between multiple members of a farm enterprise
☐ Other: _____

20. How would you rate the OFT web portal in terms of the following potential benefits?

	No use (1)	(2)	Moderately useful (3)	(4)	Extremely useful (5)	Unsure
Providing a basis for decision making	☐	☐	☐	☐	☐	☐
Reduced time in sourcing trial data and findings	☐	☐	☐	☐	☐	☐
Providing a basis for farm planning	☐	☐	☐	☐	☐	☐
Providing legacy data	☐	☐	☐	☐	☐	☐
Reducing duplication of farm trials	☐	☐	☐	☐	☐	☐
Supporting productivity savings within a farm enterprise	☐	☐	☐	☐	☐	☐

21. Please rate the value of the following components of the OFT web portal to your decision making?

	Not valuable (1)	(2)	Neutral (3)	(4)	Very important (5)
Method/treatment	☐	☐	☐	☐	☐
Trial results	☐	☐	☐	☐	☐
Soil conditions	☐	☐	☐	☐	☐
Climate	☐	☐	☐	☐	☐
Resources provided through links/attachments including GRDC	☐	☐	☐	☐	☐
Resources provided through the Report Library	☐	☐	☐	☐	☐

22. Please rate the impact of the OFT web portal in informing your decision making and in your farm/business practice and planning:

Least impact (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Most impact (10)
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

23. Please rate the following design features of the OFT web portal:

	Poor (1)	(2)	Neutral (3)	(4)	Excellent (5)	Unsure
Visual display and presentation	☐	☐	☐	☐	☐	☐
Ease of navigation	☐	☐	☐	☐	☐	☐
Speed of access	☐	☐	☐	☐	☐	☐
Types of data included	☐	☐	☐	☐	☐	☐
Links to other resources	☐	☐	☐	☐	☐	☐
Search functions	☐	☐	☐	☐	☐	☐
User-friendly interface	☐	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐	☐

24. Have you viewed any of the following training videos? (Check any that apply)

☐ Online Farm Trials: Trial Explorer: Search and filter tools
☐ Online Farm Trials: Trial Explorer: Viewing trial information
☐ Online Farm Trials: Why participate in the OFT project
☐ Online Farm Trials: Case study (Malt versus Barley)
☐ Online Farm Trials: Report library: Overview
☐ I was not aware of the videos

25. Please rate the usefulness of the training videos for you in regard to the OFT web portal?

	No use (1)	(2)	Moderately useful (3)	(4)	Extremely useful (5)	Unsure
Online Farm Trials: Trial Explorer: Search and filter tools	☐	☐	☐	☐	☐	☐
Online Farm Trials: Trial Explorer: Viewing trial information	☐	☐	☐	☐	☐	☐
Online Farm Trials: Why participate in the OFT project	☐	☐	☐	☐	☐	☐
Online Farm Trials: Case study (Malt versus Barley)	☐	☐	☐	☐	☐	☐
Online Farm Trials: Report library: Overview	☐	☐	☐	☐	☐	☐

26. What would you describe as the benefits of this resource for using the OFT web portal:

_____
_

27. Are there additional features that you would like to see included on the OFT web portal?

☐ Yes ☐ No

28. What would you like to see included?

_____
_

29. Has the OFT web portal met your expectations?

☐ Yes ☐ No ☐ To some extent

30. Please provide reasons for your response:

_____
_

31. Any other comments you would like to make relating to OFT web portal?

_____
_

32. If you would like to be involved in future OFT web portal research please provide your contact details below.

Name:_____ Email: _____

Thank you for participating in this survey. Your responses have been successfully recorded.

If you have any questions, further feedback about this project or would like to participate in future OFT research, please contact one of the following researchers:

Appendix 2 Interview Schedules

Online Farm Trial (OFT) Interview Schedule

1. Please detail your experience with the OFT web portal.
   Prompts: Involvement in establishment/roll out of program
   Input into content and/or data
   Local site Management
   Use in a professional or personal capacity

2. Do you find OFT a useful resource:
   Prompts: Content
   Data Quality
   Availability and ease of access?

3. Have you used the OFT web portal more consistently or regularly than hard copy trial reports? Why/Why note?

4. What do you see as the strengths of the OFT for the agriculture sector?

5. What do you see as the strengths of the OFT for your own professional and personal needs?

6. In what ways do you use OFT web portal?
   Prompts: for general information
   For consultancy work
   To inform decision making
   For farm planning
   For crop type and sowing decisions
   As a discussion point with family members in intergenerational farm Enterprises
   Other?

7. Do you believe that OFT has provided a mechanism to enhance farm decision making and farm practice? In what ways?

   Prompts: By highlighting trail duplications
   By enabling tracking of cropping trends
   By increasing capacity for knowledge access and informed decision making in the agricultural sector
   By shaping farming decision-making processes (e.g. application of chemicals, seeding rates, row spacing)

8. Do you believe that OFT has provided a mechanism for potential productivity savings within the farming context? In what ways?

9. Do you believe that OFT has proven to be a valuable resource for enhanced information sharing in the agricultural sector?

10. Do you believe that there are other potential data sets that could be included in the OFT portal?

11. Are there additional features that you would like to see included on the OFT portal? If yes, what are they?

12. Would you be interested in sharing (on the OFT web portal itself) information/knowledge from your farm enterprise/ your consultancy or research insights if this was an option?

13. Has OFT decreased your need to gather data from other sources?

14. Has OFT, and the information it provides to you as a researcher/consultant/farmer, met your expectations? In what ways?

15. Do you believe that OFT has made it easier to more readily identify knowledge and information gaps relevant to cropping and farm trials?

16. Which elements of OFT do you access the most and what are the reasons for this?

17. In regard to the functionality of OFT, could you indicate how effective you find:

    a. The search function and the capacity to use keywords
    b. Filtering tools
    c. Direct access to the trial reports
    d. The project reports
    e. Being able to search across grower groups
    f. The report library
    g. The trials themselves and which aspects of these

18. Are there other comments you would like to make relating to OFT?

Online Farm Trial (OFT) Web Portal Interview Schedule
National Research Organisation

1. Please provide an overview of your organisation, the type of work undertaken within it and your organisational role

2. Please detail your experience with the OFT web portal.
   Prompts: Involvement in establishment/roll out of program
   Input into content and/or data
   Local site Management
   Use in a professional capacity

3. As an organisation which is a producer of trial information, could you provide some insights into whether OFT as a technological resource, has been beneficial to your organisational planning and resource development:
   Prompts: Content, including determining what data is collected
   How data is presented
   Data Quality
   Exploring work of other groups and organisations
   Provision of legacy data
   Availability and ease of access
   Provision of research ready data sets

4. What do you see as the strengths of the OFT for the agriculture sector?

5. Do you believe that the OFT web portal has had a role in influencing how information is provided and accessed in the agricultural sector, by end users?

6. Do you believe that the OFT web portal has had any influence in knowledge management approaches in other areas of the agricultural sector?
   Prompts: Moving from hard to soft copy data
   Decreasing barriers to knowledge sharing
7. Do you believe that OFT has provided a mechanism to highlight areas for change in the agricultural sector?
   Prompts: By highlighting trail duplications
   By enabling tracking of cropping trends
   By increasing capacity for knowledge access and informed decision making in the agricultural sector
   Farming decision-making processes (e.g. application of chemicals, seeding rates, row spacing)

8. Do you believe that OFT has proven to be a valuable resource for enhanced information sharing in the agricultural sector?
   Prompts e.g. government trials, commercial trials

9. Do you believe that there are other potential data sets that could be included in the OFT portal?

10. Are there additional features that you would like to see included on the OFT portal? If yes, what are they?

11. Has OFT, and the information it provides for the agricultural sector met your expectations? In what ways?

12. Do you believe that OFT has made it easier to more readily identify knowledge and information gaps relevant to cropping and farm trials (in comparison to hard copy research information).

13. Has OFT had any specific influence within the context of your own organisation?

14. Are there other comments you would like to make relating to OFT?

Appendix 3 Schedule of general and subsidiary questions for study design

1. What strategies in implementation of Online Farm Trials have worked most effectively to support and facilitate data access to the maximum numbers of potential end users?
   Subsidiary Questions
   - 1.1 What factors were influential in end user decisions to access OFT?
   - 1.2 What factors provided a deterrent to the adoption of OFT by end users?
   - 1.3 Which elements of the OFT portal are most valued by end users? Why?
   - 1.4 To what extent was access and use of OFT determined by user group type, age, perceptions around best practice approaches to farming practice?

2. What approaches applied during the eResearch relationship were found to maximise stakeholder input to the knowledge building process?
   Subsidiary Questions
   - 2.1 To what extent is OFT a resource which supports end users to provide feedback/data which can be used to improve existing data sets and/or identify new data sets?
   - 2.2 In what practical ways does OFT facilitate maximise stakeholder input?
   - 2.3 What aspects of how OFT operates potentially minimise stakeholder input?

3 What have been the key impacts of Online Farm Trials for a range of key stakeholders, including growers, farming groups, researchers and agronomists?
   Subsidiary Questions:
   - 3.1 In what specific ways have OFT influenced the behaviour of key stakeholders?
   - 3.2 How has OFT enhanced end user knowledge?
   - 3.3 How has OFT informed end user decision making?
   - 3.4 What are the attitudes of key stakeholders around OFT as a decision making support resource?
   - 3.5 To what extent has OFT become integral to the decision-making process within the practice environment?

4 How have Online Farm Trials effectively captured data that can be used to build evidence based knowledge repositories to maximise access and minimise research duplication over the longer term?
   Subsidiary Questions
   - 4.1 Does the data accessible through OFT provide an effective evidence base for field/practice planning?
   - 4.2 Does the data accessible through OFT decrease the need for data collection in specific areas?
   - 4.3 Does OFT act as a mechanism to minimise data duplication?
   - 4.4 Has the OFT provided a mechanism to more readily identify gaps in available data and/or result in data discoveries?

5 In what ways does open data access, as provided through the tools and mechanisms of eResearch, impact on decision making and facilitate practice change?
   Subsidiary Questions
   - 5.1 Is an open data access initiatives such as OFT seen as a potential resource for end users in making decisions?
   - 5.2 In what specific ways does access to OFT data inform decision making and farm planning?
   - 5.3 What specific information is most often used to inform decision making?
   - 5.4 What (if any) is the relationship between OFT, practice decisions relating to yield and profitability and overall decision making for farm practice?

5.5 To what extent is OFT a decision making support tool used directly by farmers as end users, as against other stakeholders (such as agronomists) who act in a consultancy capacity for farm planning decision making?

5.6 What is the role of OFT given issues of aging farm populations and intergenerational farm planning?

Appendix 4 Level 1 rating scale and criteria for ratings allocation

Factor	Rating scale: allocated at the point of analysis: interview, survey and analytics data	
Level and Frequency of Usage	1	Levels of usage are extremely low and show no indication of an upward trend between implementation and the point of data collection.
	2	The level of usage has shown a consistent increase across each month since establishment, with the usage trend beginning to emerge as an upward one
	3	The documented levels of usage shows that there is a growing level of interest in use of OFT. While usage rates have not reached optimum levels, analysis for each month shows some increase in usage and a continuing upward trend in the level of site use.
Assessment of content quality	1	The quality of information, as assessed by end users, was consistently viewed as being of a low standard in terms of accuracy and appropriateness of content for meeting user needs
	2	The quality of information, as assessed by end users, was consistently viewed as being of a medium standard in terms of accuracy and appropriateness of content in meeting user needs.
	3	The quality of information, as assessed by end users, was consistently viewed as being of a high standard in terms of meeting user needs and, in instances where there is a quality issue, end users consistently see this as a collective issues and ensure that this is addressed through provision of feedback and/or the provision of new information, as required.
Usability and Navigability	1	Feedback indicates that the portal is considered to be difficult to navigate, is not considered to be visually appealing and the purpose and function of the site is not clear for the user when accessing the site.
	2	Feedback indicates that the portal is easy to navigate, the options provided within it are assessed as visually appealing and the user is able to view information and overlays of information without difficulty. Visual aspects of the portal are assessed as providing new information and perspectives to support end users within the context of sector information and planning requirements.
	3	The portal has visual aspects that are unique and not found at other sites. Navigation is intuitive and the data sets enable the presentation of spatial maps, grains legacy data, and cross site comparative data. The visual and content aspects of the portal are presented in a way that enables the user to access information that captures what they view as integral to informed decision making

Factor	Rating scale: allocated at the point of analysis: interview, survey and analytics data	
Usefulness of Content	1	There were few or no examples able to be provided of instances in which the content of OFT was assessed as having been useful, or having the potential to be useful, in meeting the personal and/or professional needs of end users.
	2	There were numerous examples able to be provided of instances in which the content of OFT was able to be assessed as having been useful, or having the potential to be useful, in meeting the personal and/or professional needs of end users.
	3	There were consistent and significant examples of usefulness or potential usefulness of OFT content in supporting and meeting the needs of the individual and the sector for planning and decision making
Level of support provided in establishment and usage	1	There were few or no indicators found that there were established processes to maximise inclusiveness through the provision of support by the OFT implementation team.
	2	There were a number of indicators found that there were well established processes in place to maximise inclusiveness through the provision of support by the OFT implementation team
	3	There were clear and well documented processes and/or mechanisms in place to facilitate the allocation of roles and responsibilities and to establish processes of inclusiveness across end user groups. The nature of these process could be assessed as being likely to result in good level of end user confidence in the support structures offered through the OFT implementation team.
Participant experiences of the innovation	1	There were very few or no identified examples of users having had a positive experience when accessing or working with OFT. There was no indication that OFT was assessed as a valuable resource or one that had relevance for end users. There was little or no indication given that issues or concerns identified with OFT had been critically reviewed, with the aim of putting in place measures to address these.
	2	There were some examples, of instances in which users had had a positive experience when access or working with OFT. There was a reasonable indication that OFT assessed as a valuable resource or one that had potential to have relevance for end users into the longer term. There was some reasonable indication given that issues or concerns identified with OFT had been critically reviewed, with the aim of putting in place measures to address these.
	3	There were consistent examples provided of instances in which users had had a positive and engaging experience when access or working with OFT. There was a consistent and strong indication that OFT assessed as a valuable resource or one that had high levels of potential for meeting end user needs. There was a very strong indication given that issues or concerns identified with OFT had been critically reviewed, with the aim of putting in place measures to address these.

Factor	Rating scale: allocated at the point of analysis: interview, survey and analytics data	
Trust in the Resource	1	There were few messages and/or there was specific negative feedback provided, throughout embedded feedback mechanisms and through research processes, relating to end users trust of the content and applicability of OFT. There was minimal confidence expressed that content could be used to informing decision making
	2	There were a range of examples found, throughout embedded feedback mechanisms and through research processes relating to end users trust of the content and applicability of OFT. There was a good level of confidence expressed that the content could be used to inform decision making and to expand knowledge through legacy data and comparative analysis of locational differences.
	3	There was an overt and consistent message provided, throughout embedded feedback mechanisms and through research processes relating to end users trust of the content and applicability of OFT. There was a very strong level of confidence expressed that the content could be used to inform decision making and to expand knowledge through legacy data and comparative analysis of locational differences.
Potential for further development relevant to the sector	1	There were few or no indicators provided that participants could identify the potential of OFT (either currently or in the future) to be used as a resource with capacity to enhance and support future development initiatives within the sector and/or for research and data discovery. There were no indicators that the resource could provide foundational data which, in combination with other information, would be a key resource for the facilitation and support of decision-making process
	2	There were a range of examples provided that participants could identify the potential of OFT (either currently or in the future) to be used as a resource with capacity to enhance and support future development initiatives within the sector and/or for research and data discovery. There were no indicators that the resource could provide foundational data which, in combination with other information, would be a key resource for the facilitation and support of decision-making process
	3	There was an overt and consistent message provided that participants could identify the potential of OFT (either currently or in the future) to be used as a resource with capacity to enhance and support future development initiatives within the sector and/or for research and data discovery. There were no indicators that the resource could provide foundational data which, in combination with other information, would be a key resource for the facilitation and support of decision-making process