Conceptual and methodological opportunities for the Victorian DPI with systems thinking and practice

Final Report

Ray Ison, Andrea Grant, Ben Iaquinto, Josh Floyd, Victor Sposito and Rob Faggian

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CONCEPTUAL AND METHODOLOGICAL OPPORTUNITIES FOR THE VICTORIAN DPI WITH SYSTEMS THINKING AND PRACTICE

FINAL REPORT
(PHASE ONE)

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### Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AEA</td>
<td>Agroecosystems analysis</td>
</tr>
<tr>
<td>ACF</td>
<td>Australian Conservation Foundation</td>
</tr>
<tr>
<td>APSC</td>
<td>Australian Public Service Commission</td>
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<tr>
<td>ARC</td>
<td>Australian Research Council</td>
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<tr>
<td>CCA</td>
<td>climate change adaptation</td>
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<tr>
<td>CoP</td>
<td>community of practice</td>
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<tr>
<td>DPCD</td>
<td>Department of Planning and Community Development</td>
</tr>
<tr>
<td>DPI</td>
<td>Department of Primary Industries</td>
</tr>
<tr>
<td>DSE</td>
<td>Department of Sustainability and Environment</td>
</tr>
<tr>
<td>FFSRD</td>
<td>Future Farming Systems Research Division</td>
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<tr>
<td>FSR</td>
<td>Farming systems research</td>
</tr>
<tr>
<td>FSV</td>
<td>Farm Services Victoria</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>NCCRSPI</td>
<td>National Climate Change Research Strategy for Primary Industries</td>
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<tr>
<td>PAGE</td>
<td>Pilot Analysis of Global Ecosystems</td>
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<tr>
<td>PRA</td>
<td>Participatory rural appraisal</td>
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<tr>
<td>P&amp;SG</td>
<td>(DPI) Policy and Strategy Group</td>
</tr>
<tr>
<td>RRA</td>
<td>Rapid rural appraisal</td>
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<tr>
<td>SDI</td>
<td>Systemic Development Institute</td>
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<tr>
<td>SUAN</td>
<td>South-East Asian Universities Agroecosystem Network</td>
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<tr>
<td>VCCAP</td>
<td>Victorian Climate Change Adaptation Program</td>
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“Systems thinking by itself cannot bridge that gap (between understanding and action), but it can lead us to the edge of what analysis can do and then point beyond – to what can and must be done by the human spirit.” (Meadows, 2008)

Executive Summary

Main findings and recommendations

1. DPI (FFSRD) is well positioned to provide much needed strategic and operational leadership in building systems thinking and practice capability within the public sector. This need is increasingly recognised particularly in the light of intractable public policy issues like climate change adaptation (CCA).

2. The greatest opportunities available to FFSRD based on Systems approaches are:
   2.1. introducing appropriate Systems approaches into project development and management;
   2.2. strengthening DPI’s commitment to developing and sustaining CoPs (communities of practice) as pivotal sites for ‘knowledge brokering;
   2.3. enabling work teams, including the senior management team, to engage in Systems capability building workshops in which real-time complex issues are worked with;
   2.4. managing so as to avoid constraining Systems to ‘project silos’ i.e. conceptualising Systems as a cross-cutting theme across all or many projects;
   2.5. to experiment with different methods so that FFSRD can build better stakeholding amongst key constituencies and thus better secure its strategic objectives;
   2.6. to recognise the changing political and practical needs of regional Australia and the systemic nature of these issues so as to further develop DPI’s Systems science capabilities for dealing with local and regional CCA responses.

3. Systems approaches (e.g. causal loop mapping) were able to effectively demonstrate how some past DPI research objectives had led to unintended consequences for anticipated beneficiaries. The opportunity exists for using systems approaches ex post and ex ante to reduce the risk of systemic failure or unintended, ‘surprise’ outcomes as part of future project and program management;

4. The research established that there was limited conceptual integration of CCA research despite the good intentions of the researchers and directors:
   4.1. It is recommended that DPI (FFSRD) pay more attention in program and project development to critically examining the ‘initial starting conditions’, ‘frames’ used by different stakeholders and the potential unintended consequences of ‘pathway dependency’. These are all concepts of concern to systems theorists and practitioners and have been shown to impact on what DPI does.
   4.2. In complex systems, the sensitivity of innovations to initial starting conditions is now well known. Path dependence explains how the set of decisions that are faced for any given circumstance is limited by the decisions made in the past,
even though past circumstances may no longer be relevant. DPI needs to explore how ‘path dependence’ constrains innovation and achieving joined-up government.

4.3. The research revealed no explicit understanding of what a future farming operation that was well adapted might actually look like. It was apparent that people were working within highly uncertain contexts and understanding of needed skills and capabilities was evolving out of the context in which the climate change issues were being framed (i.e., highly sensitive to initial framings).

5. The ‘problem of climate change’ is perceived by interviewees (research managers) to be much bigger than research is able to address. There are issues in connecting up research activity to those with knowledge needs so as to increase the rate of knowledge exchange and expedite the processes of change required to accommodate anticipated changes in climate. Clearly Systems approaches offer potential advantages in such a situation.

6. DPI could benefit from adopting a set of systems practice guidelines in ongoing strategic management and especially project formulation and evaluation. Donella Meadows, of Club of Rome fame, an internationally recognised systems thinker and practitioner offered a useful starting set of nine key systemic concerns for managing in complex situations. This list, adapted to context, could be usefully applied to all projects and programs in both conception and evaluation phases:¹

   (9) Numbers (subsidies, taxes, standards)
   (8) Material stocks and flows
   (7) Regulating negative feedback loops
   (6) Driving positive feedback loops.
   (5) Information flows
   (4) The rules of the system (incentives, punishment, constraints)
   (3) The power of self-organization
   (2) The goals (or purpose) of the system
   (1) The mindset or paradigm out of which the goals, rules, feedback structure arise

7. Examples of how particular Systems approaches could be utilised in an everyday, practical manner within FFSRD are reported. However it will not be possible for DPI (FFSRD) to use such approaches without investment in capability building amongst the senior FFSRD team accompanied by high level championing of the initiative.

8. This synthesis report includes an extended Executive Summary and Chapters 1 and 7 from the final report. The remainder of the executive summary highlights the main elements of each chapter in the final report.

¹ Meadows insisted in listing these from the least (i.e., 9) to the most important (i.e., 1) from her perspective recognising that all were needed.
Chapter 1: Context and background to three inquiries

1. This report documents the main activities and findings of a research collaboration between the Victorian Department of Primary Industries (DPI) (Future Farming Systems Research Division) and members of the Systemic & Adaptive Governance Research Program, Monash Sustainability Institute, Monash University. The collaboration was initiated by DPI staff experiencing the emergence of complex, uncertain and contested issues that impacted upon their research. Drawing on international evidence it was argued that capability building in Systems was warranted as a means to better manage future strategic risk, respond better to complex and intractable policy issues, and to equip DPI to be better able to deliver to its key stakeholders.

2. The research was organised as a ‘systemic inquiry’ with three related inquiry strands (Figure 1). The overall focus was on elucidating conceptual and methodological opportunities for the DPI with systems thinking and practice whilst contributing to capability building to take advantage of these opportunities. The research was qualitative in nature and included, in total, 49 semi-structured interviews, participant observation, document analysis, workshops, conceptual advice and invited responses to initial findings by research participants.

Figure 1 A conceptual model of the elements of a ‘systemic inquiry’ undertaken as part of a DPI (FFSRD) and Monash University collaboration.

3. The overall systemic inquiry comprised three related inquiries which we have called Appreciating Initial Starting Conditions 1, 2 and 3 (Figure 1):

3.1. Inquiry 1 explored Future Farming Systems Research Division (FFSRD) managers’ perceptions, or ‘framings’ of current issues and their understandings and experiences of Systems as an academic area (Chapter 2).
3.2. Inquiry 2 concerned climate change adaptation (CCA) research as organised within the DPI through the Victorian Climate Change Adaptation Program (VCCAP). Preliminary findings about how CCA research has taken place in the DPI, mainly from the perspective of research managers, and some key stakeholders in other areas of government, is reported. The research was conducted using ethnographic methods of interview, document analysis and participant observation (Chapters 3-5). The research was exploratory in nature and designed to facilitate a future second round of inquiry into how, if at all, Systems approaches might usefully be incorporated into DPI's future CCA research repertoire.

3.3. Inquiry 3 scoped purposeful design criteria for creating a Systems community of practice (CoP) by exploring the opportunities and constraints operating with extant CoPs in the DPI (Chapter 6).

4. In Chapter 7 (included in this Synthesis Report), the main findings of all three inquiries are situated in a broader literature, and opportunities for DPI to benefit from investment in Systems are highlighted.

5. One of several opportunities for on-going collaborative research is discussed in Chapter 8 (i.e. Gippsland CCA research as depicted in Figure 1).

6. Other significant contributions made by the Monash team over the contract period are listed in Appendix 10.2.

Chapter 2: Inquiry 1 - exploring FFSR managers perceptions of issues, and understandings and experiences of Systems

7. Reflections offered by 23 FFSRD managers following interviews and a workshop indicated an overall positive predisposition towards the outcomes of the workshop (August 2009) as well as considerable enthusiasm to better deploy Systems in pursuing FFSRD's mission;

8. FFSRD managers' perceptions of the main issues that faced the DPI in mid-2009, and likely into the future, provide evidence for framing the Division's main situations of concern as 'wicked problems' or situations of uncertainty, complexity, interdependency and multiple stakeholding'. Our findings suggest a need to further explore the implications of this finding within the senior management team;

9. As organised the current Systems initiative seems, for structural reasons, unable to cater for the considerable enthusiasm for engaging with Systems amongst FFSRD managers. The workshop outcomes point to a need to enhance appreciation of the range and scope of Systems scholarship amongst FFSRD senior managers. This was generally recognised by participants. Failure to invest appropriately in this area restricts potential impact for embedding Systems approaches and for gaining the main benefits in research scoping and project development and management.

10. The findings with respect to senior managers can be contrasted with the positive evaluation of the FFSRD-sponsored Systems training program which has been attended by generally mid-level managers. The Systemic Development Institute (SDI)-run training program has been most effective when a manager and their team attend together. It is thus recommended that FFSRD management create an opportunity to engage as a team with Systems around an issue of concern.

11. FFSRD is recommended to address whether Systems Thinking and Systemic Science have to be 'projectified' and remain within named project boundaries. Our experience suggests that it can be picked up as a cross cutting innovation across all projects.
12. A major theme to emerge from Inquiries 1 and 2 concerned the adequacy, or not, of the current project management model and the way the project cycle was being implemented.

Chapters 3-5: Inquiry 2 - Climate change adaptation research

13. Climate change adaptation is appropriately framed as a ‘wicked problem’. The FFSRD Directorate and managers regard systems thinking as an important capability for the delivery of high impact science that addresses wicked problems as evidenced by funding thus far for the Systems initiative.

14. The inquiry into DPI CCA research management was based on core activities (discourses) and boundary issues (framings) found in strategic documents, interviews, research publications and observations. People were interviewed from within the pool of FFSRD research management and key areas of stakeholding in FSV, DPI P&SG, DPCD and DSE. Findings from phase one are presented. These are designed as input to a potential second phase (subject to future support for the work).

15. This inquiry was situated in a wider context of research and policy direction in which five documents from the international, national and state arenas were chosen for analysis, viz:

15.2. Land and Water Australia’s (L&WA) National Climate Change Research Strategy (2007)
15.3. Victorian Government Climate Change Framework Green Paper (2009);
15.5. DPI Agriculture and Fisheries Four Year Strategy 2009-2013 [2010-2014]

16. Inquiry 2 considered how research practice mediates adaptation planning and action by looking at participants’ different constructions of knowledge need, conceptual models of research, valuing of such concepts and connections between research activities and changes on the ground. It offers a view of how, if at all, DPI achieves what it sets out to do as a CCA researching system.

17. Strategically there has been a shift away from a corporate approach to business management in the DPI towards developing partnerships and engagement with industry, community and other stakeholders. A new strategic goal of enabling government performance, in alignment with community expectations, e.g., in areas of economic, social and environmental outcomes that include attention to community safety and wellbeing and sustainable resource management, has been articulated. Our research suggests this strategic shift is yet to be fully mirrored in the project development process. It remains to be seen if this linguistic shift in policy is accompanied by on-the-ground action.

18. The most prevalent area of knowledge need for CCA seems to be the existence of capabilities in dealing with climate uncertainty and less predictability in farming systems. This is a core concern against which all other dimensions of perceived climate change threat are linked including retaining productivity and food security, mental health and community wellbeing, competitiveness and business sustainability, and reactionary rather than anticipatory politics. Dealing with climate uncertainty and less predictability converges in a range of research conceptualisations. Better understanding of environmental interactions, recognising social-economic consequences, improving capacity for shared responsibility, building local relevance of policy and science, and facilitating new research relationships all require attention as a response to handling uncertainty and a lack of predictability.
19. There is evidence that what is being valued in research as a result of focusing on climate change is shifting. Research is moving from a static environment of knowledge production focused on underlying causes to a dynamic one of understanding complex interactions and the patterns they give rise to. At the moment research is valued in a diversity of ways from the traditional, focused on ongoing production efficiencies, to concerns linking present decisions with future outcomes. Value is also placed on realising the conditions through which innovation could be optimised, facilitating a shared vision for investment, and in developing dynamic modelling capability that can support an understanding of the interaction between climate change biophysical and social realities.

20. Some of the areas in which research is linked-up are viewed in the context of developing capabilities for dealing with climate uncertainty and less predictability. This represents an approach that builds CCA research practice through a model of organisational learning. There are four areas in which this approach is being or could potentially be realised:

20.1. through recognising the difference between formal and informal research networks;
20.2. through recognition of new biophysical and sociocultural relationship through research, rewarding feedback and collaboration with research users;
20.3. by connecting across disciplines, concepts and models; and
20.4. organisational structures to support integration.

21. The research established that there was limited conceptual integration of CCA research despite the good intentions of the researchers and directors. Findings indicate that there is recognition of the benefits of Systems techniques and methods for practitioners to engage across disciplines and support stronger integration of research with practical outcomes of CCA. While there has been progress made in the DPI in taking a more holistic view of the use-values of research, it has not yet been able to realise the potential for more joined-up activity in the design and implementation of CCA research.

22. There was no explicit understanding of what a future farming operation that was well adapted might actually look like. It was apparent that people were working within a context which was highly uncertain and understanding of needed skills and capabilities was evolving out of the context in which the climate change issues were being framed (i.e., highly sensitive to initial framings).

23. There are useful tools and techniques from the portfolio of systems theory and practice that can assist in recognising the origins of difference within disciplinary theories and methods and how they might be accommodated through focus on purpose, issue ownership and improved systemic performance. It was clear from interviews that whilst some attention was paid to facilitating collaboration at the time of project initiation there was little attention paid to maintaining collaborative efforts. This resulted in a tendency for people to fall back into their comfort zones. The hard work of conceptual integration was left to someone at the end of the cycle of project management to try and bring all the disparate parts together.

24. It was clear from participants’ perspectives that there were different types of stakeholder with different types of knowledge need. However it was not apparent from reading the strategy documents that this was the field that DPI was working within. These findings challenge the tradition of working with industry stakeholders largely represented by peak industry bodies towards greater cross-industry collaborations and inclusion of a wider range of stakeholders. With the issue of climate change DPI was not just addressing knowledge needs of industry but also of other stakeholders in
government including policy and a variety of other governing bodies, regional, industry and research communities.

25. Against the certainties and stabilities of past research performance in improved productivity and publication rates there is a need for better techniques for understanding and managing uncertainty and risk as emergent properties of complex interactions. To become more open to and realise emergence and the opportunities for new ways of stabilising livelihoods against a more dynamic global market and climate, there is need to focus on knowledge resources as interpretive capabilities and not just information flows.

26. Constraints in realising a transformation towards more systemic and integrated approaches to CCA research were identified. These are largely based on traditions of research management practice established in the ‘new public management’ paradigm, which at times inappropriately applies linear modes of process management to complex and uncertain issues. It appears, from participants’ perspectives, that the existing structures and cultures of management do not necessarily support the communicative spaces required to accommodate different perspectives and different ways of understanding climate change problem framing.

27. Some opportunities for including a wider view of research as acting within a set of interacting social and biophysical ‘systems’, highly valued by respondents, were identified. These show the potential for increasing the relevance of research for its main beneficiaries. Positive experiences of engaging in small group discussion and facilitating multi-stakeholder visioning exercises for defining research objectives have made notable differences in the perceived coherence between research design and implementation.

28. It seems that the ‘problem of climate change’ is perceived by participants to be much bigger than research is able to address. There are issues in connecting up research activity to those with knowledge needs so as to increase the rate of knowledge exchange and expedite the processes of change required to accommodate anticipated changes in climate. Clearly Systems approaches offer potential advantages in such a situation. Some of the significant barriers to research making a difference were seen as research distance from decision makers; psychological barriers and denial; raising awareness in the community; and project funding and management.

29. CCA research requires a form of understanding in a dynamic environment which constitutes a change in approach to traditional decision modelling platforms. It is not just a matter of bringing together different sets of data but recognising observed effects are produced in complex interactions between natural and social phenomena. There are interactions between natural phenomena from which data is gathered (e.g., plant and animal metabolism) but there are also interactions between social phenomena in which data is gathered (e.g., funding arrangement, expertise and collaborations, methodologies and epistemologies). Some effects of complex interactions may be beneficial and others detrimental to achieving sustainable livelihoods in dynamic climate and market conditions. This more complex environment of knowledge production and use requires new ways of conceptualising research management practice to which systems methodologies are well suited.

30. It is clear that DPI is undergoing a transformation towards accommodating a greater range of engagement with industry, community and other stakeholders and enabling departmental performance. What seems important is that these processes cannot be assumed to occur as intended. Experience has shown that processes involving diverse stakeholding and novel relationships require conditions for building trust, recognising and accommodating differences in subjectivity and worldview. In other words closer engagement requires a set of practices that existing management may
not be equipped to coordinate. Furthermore some of the structures of linear management would be inappropriate for open and contingent decision contexts, where the outcome of discussions cannot be known in advance.

31. CCA research requires a form of understanding in a dynamic environment which constitutes a change in approach to traditional decision modelling platforms. It is not just a matter of bringing together different sets of data but recognising observed effects are produced in complex interactions between natural and social phenomena. There are interactions between natural phenomena from which data is gathered (e.g., plant and animal metabolism) but there are also interactions between social phenomena in which data is gathered (e.g., funding arrangements, expertise and collaborations, methodologies and epistemologies). Some effects of complex interactions may be beneficial and others detrimental to achieving sustainable livelihoods in dynamic climate and market conditions. This more complex environment of knowledge production and use requires new ways of conceptualising research management practice to which systems methodologies are well suited.

32. There is a need in CCA research for recognition that policy actions will have effects, some desired and some detrimental, on the ability of stakeholders to realise sustainable livelihoods under changed climate conditions and responses to them. DPI needs to focus understanding on how, through better monitoring and evaluation, it can build capability in organisational learning to respond to changes that are:

32.1. the effect of policy actions; or
32.2. the effect of inaction in relation to change occurring in the natural environment and sociocultural responses to changes in climate.

In effect this means DPI realising itself as part of a dynamic system in which actions result in consequences that change the initial dynamic of interaction between social, technological and ecological systems. Based on these findings there are a number of opportunities for design and development of systems theory and praxis to support the transition towards a more systemic and adaptive research management framework:

32.3. Connecting research up to decision makers in policy, business and communities through theory informed processes of research design and development;
32.4. Increasing dialogues within internal and external communities of interest to engage with CCA research issues;
32.5. Facilitating co-research with farmers and others willing to innovate as a device for opening up areas of leadership in CCA; and
32.6. Facilitating social learning (Ison et al 2007) for increasing capacity in research management of complex issues.

Chapter 6: Inquiry 3 - scoping purposeful design for creating a Systems community of practice

33. Six CoPs that were purposefully created internally by the DPI were found to exist. Six ‘design’ and practice considerations for creating and sustaining successful CoPs were identified:

33.1. Dispersal creates a need - the dispersal of development and learning practitioners across the state and throughout different organisational divisions creates an obvious need for a CoP. A CoP acts as a way to collaborate over distance and share expertise across divisional boundaries.
33.2. Awareness of Limitations – the identification of limitations and open communication about improvement indicates members are enthusiastic about improving their situation and are thus committed to its success.
33.3. One Coordinator - one of the DPI’s most successful CoPs has had the same coordinator throughout its life. This coordinator has thus been able to establish recognition and to become highly networked throughout the DPI.

33.4. High Level Sponsor – DPI experience, supported by other research, shows that the acquisition of high-level management support is important to ensure the long term viability of CoPs.

33.5. Pre-existing Social Capital - the use of preexisting social networks for the purposeful design of CoPs has been advocated and this study demonstrated that such a strategy can be successful. 

33.6. Core Business – CoPs function effectively when the subject matter is core business.

34. The value of CoPs still appears to be under-acknowledged by DPI’s higher management. To help maintain CoPs, there needs to be a way for their worth to be demonstrated to higher management. It is clear that not all of the six conditions (above) were in place for the creation and sustaining of a Systems CoP.

35. Recommendations specific to DPI arising from Inquiry 3, in addition to the conclusions of the published research paper (Chapter 6), include:

35.1. Recommendations re Systems CoP

35.1.1. Make links between systems thinking/practice and climate change adaptation as a way to promote systems concepts throughout DPI (i.e. introduce a systems strand to the climate change CoP).

35.1.2. Foster more social and relational capital amongst systems thinkers across DPI, through the following possibilities:

35.1.2.1. Invest in reinvigorating the STCoP (Systems thinking CoP);

35.1.2.2. Build (rebuild) stakeholding in the STCoP through forming a cross division steering group from which the coordination function is resolved;

35.1.2.3. Re-explore and re-articulating purpose in the revitalised constituency.

35.1.3. Identify and recruit new champions.

35.1.4. Build formal ‘scaffolding’ arrangements with external collaborators with similar interests

35.2. Recommendations to DPI management

35.2.1. Allow more time for CoP participation by staff (e.g. through KPIs).

35.2.2. Determine if HR division could design/manage CoPs.

35.3. Recommendations for CoP coordinators

35.3.1. Establish a CoP for CoP coordinators for support and as a way to share admin tips.

35.3.2. Establish a means to change coordinators that minimises loss of expertise and maintains CoP momentum.

35.4. Recommendations for CoP members

35.4.1. Take a more active role in CoP success.

35.4.2. Provide support to coordinator in day-to-day CoP functioning.

35.4.3. Continue to address whatever generates enthusiasm.
Chapter 7: Strategic opportunities for FFSR within DPI, and beyond, based on Systems capabilities

36. Examples of how particular Systems approaches could be utilised in an everyday, practical manner within FFSRD are given. However it will not be possible to use such approaches without capability building amongst the senior FFSRD team and high level championing of the initiative;

37. Systems thinking is employed to raises matters that may come to affect FFSRD’s strategic direction. These include the consideration that future agricultures are the product of design which in turn prompts the question: who are, or should be, the designers? It also raises questions about the design process, e.g. through foresight activity or other design processes such as Agroecosystems Analysis (Appendix 10.9) or other Systems approaches;

38. The three inquiries undertaken as part of this collaboration indicate evidence of need and opportunity for enhancing capability for deploying Systems approaches in research practice.

Chapter 8: Strategic opportunities for FFSR within DPI, and beyond, based on Systems capabilities

39. This chapter outlines an opportunity for the DPI CCA research community for further engagement with the Monash;

40. In Inquiry 2 participants identified the following barriers to CCA research making a difference on the ground:

40.1. research distance from decision makers;
40.2. psychological barriers and denial;
40.3. raising awareness in the community;
40.4. project funding and management.

41. Participants perspectives on how to improve the situation were classified into five key areas for potential intervention and innovation:

41.1. breaking conceptual barriers to integration including building capability in collaboration;
41.2. developing opportunities to do things differently by including end users of research in the research design process and through focus on particular issues or local context;
41.3. being explicitly aware of historical aspects of the situation including the changed relations and new issues associated with new challenges for development;
41.4. taking a step back to improve perspective on what often seems to be fragmented opportunities of foresight and intervention; and
41.5. overcoming barriers to building adaptive capacity through discussions that enable a view of local interactions between climate and environment in different timescales.

42. Four opportunities for design and development of systems theory and praxis were identified:

42.1. Connecting research up to decision makers in policy, business and communities through theory informed processes of research design and development
42.2. Increasing dialogues within internal and external communities of interest to engage with CCA research issues

42.3. Facilitating co-research with farmers and others willing to innovate as a device for opening up areas of leadership in CCA

42.4. Facilitating social learning (Ison et al 2007) for development and management of CCA research as a social technology for increasing capacity in research management of complex issues.
Chapter 1 Introduction

1.1 Introduction

The situation of agriculture in Victoria can be characterized as one in which there are many interdependencies, complexity, uncertainty, controversy and multiple stakeholders (and thus multiple perspectives) – particularly on the nature of change and future directions. Andrew Campbell, in his report “Paddock to Plate (ACF, 2008), highlighted many of these features. In a presentation to the FFSR Division of the Department of Primary Industries, Victoria (DPI) (2008) he made the following points:

- a. We are living through a period of unprecedented environmental change that is likely to intensify - this is not a blip
- b. Business as usual is not a viable trajectory
- c. The Victorian food system needs to improve its performance irrespective of climate change
- d. Climate change raises the stakes & increases the risks
- e. Victoria can lead a new approach to food in a drying climate
- f. This is about innovation, regional development & leadership
- g. New alliances are needed across the health, food and farming systems, and along the food value chain
- h. Smart R&D is on the critical path
- i. Incremental tweaks to status quo won’t do.

Concurrent with similar inquiries into the future of agriculture in Australia, the Australian Public Service Commission (APSC), in a seminal paper in 2007, looked at the issue of policy failure in response to long-term, intractable ‘wicked problems’ of which climate change, land degradation and river catchment managing can be regarded as examples. The paper’s authors argued for capability building in skills and understandings for engaging with, and managing, ‘wicked problem situations’, especially developing systems thinking skills. In a later paper (2009) the APSC observed that: ‘governments are facing new policy challenges, such as climate change, water scarcity, Indigenous welfare, and diseases linked strongly to lifestyle, problems which traditional techniques do not seem able to address effectively. These problems are difficult to identify and solve as they have multiple causes interacting in complex ways that are not well understood. As then Prime Minister, Hon. Kevin Rudd MP, stated, ‘… a business as usual approach … is not working. Most old approaches are not working. We need a new beginning.’ ……. The new modes of policy implementation are collaborative and can seem unstructured or messy. They require levels of risk taking, experimentation and engagement with communities that do not fit comfortably within current accountability and performance management arrangements’ (p. 1-2).

Under current and projected climates agriculture is highly likely to be constrained by reduced water, higher temperatures, extreme events with impacts on the supply and quality of food (Henessey et al 2008; Larsen et al 2008). Corresponding actions are needed to counteract these impacts and the DPI is well positioned to make a contribution to the challenges of climate change. Opportunities exits for investing in research to assist in understanding climate impacts and enabling timely and effective adaptation responses. However, in the wider context, climate change is framed as a complex and seemingly intractable ‘wicked’ problem (APSC 2007) that will require different approaches to governing intervention in response to changes in standards of ‘fact’ and ‘value’.

Against this backdrop a program of work commenced in June 2009 as a collaboration between DPI (Future Farming Systems Research Division) and members of the Systemic & Adaptive Governance Research Program, Monash Sustainability Institute. The contracted schedule of work is shown in Appendix 10.1. We summarise this schedule as
undertaking research which elucidates conceptual and methodological opportunities for the Victorian DPI with systems thinking and practice whilst contributing to capability building to take advantage of these opportunities. From inception it was recognised that limited advances could be achieved in one year – hence our description of this work as ‘phase 1’.

This report is concerned with three distinct, but related inquiries. These can be understood as Appreciating Initial Starting Conditions 1, 2 and 3 (Figure 1.1). Other significant contributions made by the Monash team over the contract period are listed in Appendix 10.2.

![Figure 1.1 A conceptual model of the elements of a ‘systemic inquiry’ undertaken as part of a DPI (FFSRD) and Monash University collaboration.](image)

This research is contextualised within a broader initiative being undertaken by the DPI concerned with the development and application of Systems Thinking (ST) and Systemic Science in DPI (Figure 1.2).

![Figure 1.2 Schema outlining the main features of the Systems Thinking and Systemic Science initiative within DPI as conceptualised in early 2009.](image)
1.2 Understanding context

The research design employed is based on the understanding that context has to be understood as part of considering and delivering new innovations (Ison et al 2008). It is within unique contexts that initial starting conditions for any new activity can be found which may create pathway dependencies that either constrain or enhance the likely success of an innovation (Box 1.1).

### Box 1.1 Initial starting conditions, ‘framing’ and pathway dependency

‘Initial starting conditions’, ‘frames’ and ‘pathway dependency’ are all concepts of concern to systems theorists and practitioners.

In complex systems the sensitivity to initial starting conditions of unfolding dynamics is now well known (see [http://en.wikipedia.org/wiki/Butterfly_effect](http://en.wikipedia.org/wiki/Butterfly_effect)). Organizations and forms of social organisation such as large projects can usefully be understood as a complex adaptive systems that are, in their trajectory, sensitive to initial starting conditions.

In social research the concept of ‘initial starting conditions’, well understood in relation to physical phenomena can be extended through the idea of ‘framing’. An expanded discussion of framing can be found in Appendix 10.3.

Path dependence explains how the set of decisions that are faced ‘for any given circumstance is limited by the decisions one has made in the past, even though past circumstances may no longer be relevant. In economics and the social sciences path dependence can refer to either outcomes at a single moment in time or to long run equilibria of a process. In common usage, the phrase implies either:

(i) that "history matters" or
(ii) that predictable amplifications of small differences are a disproportionate cause of later circumstances’ (see [http://en.wikipedia.org/wiki/Path_dependence](http://en.wikipedia.org/wiki/Path_dependence)).

In the absence of an appreciation of context, and thus what initial starting conditions exist, the history of the situation, the explicit or implicit ‘framing conditions, innovations can fail. Innovations may be ideas, institutional arrangements, practices, services, or technologies.

The UK Royal Commission on Environmental Pollution (RCEP), reporting in March 2010 on ‘adapting institutions to climate change’ found that: ‘Path dependency, or an over-reliance on the way things have always been done, may make it difficult to establish new ways of working that could be beneficial in adapting to climate change’ (RCEP, 2009 p. 13).

Three aspects of context have been explored using ‘systemic inquiry (Figure 1.1.; Box 1.2) as the key framing of the overall research program. The first pertained to the understandings and perceptions held by senior DPI staff from the FFSR Division about the nature of the strategic issues and risks that they, and Victorian agriculture, faced in mid 2009. The research also explored within the FFSR senior team, the diversity of understandings and experiences of systems thinking and practice. An interactive workshop with FFSR staff allowed those present to explore the implications of what had emerged for the DPI’s on-going management of strategic issues and risks as it specifically applies to the FFSR Division. We will call this inquiry Appreciating Initial Starting Conditions 1 and report on it in Chapter 2.

Considerations of climate change are, or will be, pervasive in all that is done in the foreseeable future. Climate change adaptation (CCA) will be of particular concern (Collins...
The DPI has been at the forefront of climate change research in Victoria and Australia building on, and complementing other national and international efforts. The main programme of concern to FFSR staff was that undertaken under the auspices of VCCAP (Victorian Climate Change Adaptation Program). In all $2.3 million per annum was committed to VCCAP research with an additional $1 million in the first year. DPI also committed another $16 million to climate-related research over two years from 2008.

Appreciating Initial Starting Conditions 2 involved the initiation of a systemic inquiry (Box 1.2) into the understandings and practices of research managers concerned with projects falling under the auspices of VCCAP. The primary aim of the this inquiry was to surface issues associated with initial starting conditions, framings and possible path dependencies that had arisen historically and were still in play through the functioning of VCCAP. This was not evaluative research, but an inquiry designed to learn about current circumstances in a way that could help build future capability and systemic innovation in climate change adaptation (CCA) research in the DPI. This inquiry rests on a number of premises:

(i) that climate change research is a new form of research practice;
(ii) that the domain of climate change, especially CCA, is a situation characterised by uncertainty, complexity and surprise (Ison et al 2007);
(iii) that traditional approaches to research practice, including traditional project management, may have limitations in this domain, and
(iv) that systems thinking and practice may have useful contributions to make to DPI’s future climate change research practice. ²

The background and methodology for this inquiry are reported in Chapter 3. The findings are in Chapter 4, results and discussion in Chapter 5 with main recommendations developed in Chapters 7 and 8. This inquiry begins by considering CCA research within a wider context including international, national, state and DPI policy responses. It also examines the actual practice of climate change research within DPI and some other state government departments, using qualitative research methods.

One of the actions taken at the beginning of the DPI initiative with ‘systems science’ (2008-9) was to establish a Systems Community of Practice (CoP). This action was consistent with developing in-house practice which in many ways is highly innovative and at the cutting edge of emerging ‘knowledge management’ initiatives internationally. However it was clear from the beginning of this research contract that just what a CoP was, in the context of DPI, was far from clear. It thus became apparent that some understanding of the historical development and functioning of CoPs in the DPI was required to guide the establishment of a Systems CoP with the potential to succeed. Scoping research was undertaken so as to better understand the role and functioning of CoPs within DPI as part of a broader question about the role of CoPs within public sector organisations. The outcomes of this research have been published in the Journal of Knowledge Management which is included here as Chapter 6 (Appreciating Initial Starting Conditions 3). Recommendations for specific actions by the DPI are added as are research questions that the DPI may wish to explore.

² The research, conducted by Andrea Grant and led by Prof. Ray Ison from Monash University, is a major component of the first phase of collaboration between the DPI and the Monash Sustainability Institute (MSI) in the project titled: ‘Systems thinking: capability development and application’. Rob Faggian and Victor Sposito have led the project from within the DPI’s Future Farming Systems Research (FFSR) program. The research has also involved working with selected DPI staff and research stakeholders in the Department of Planning and Community Development (DPCD), the DPI Policy and Strategy Group (P&SG) and the Department of Sustainability and Environment (DSE) to build up a systemic appreciation of current CCA research management practice.
Box 1.2 Systemic inquiry

Systemic inquiry is a practical approach open to all practitioners who wish to acknowledge the uncertainty of particular situations. It has been pioneered in a number of research settings including contracted research with the Environment Agency of England & Wales (Collins et al 2005; Ison 2010). Systemic inquiry can also be understood as a meta-platform or process for ‘project or program managing’ as well as a particular means of facilitating movement towards social learning (understood as concerted action by multiple stakeholders) in situations of complexity and uncertainty.

It can be argued that ‘it is no longer tenable in a climate changing world to have almost all that we do ‘framed’ by our invention of ‘the project’ (Winter & Checkland 2003; Winter and Szczepanek, 2009; Ison 2010). Bell and Morse (2005) describe a project as ‘defined activities carried out by defined people with a defined end point in mind at a defined cost and over a defined period of time’ [p.97]. They go on to outline how ‘projects are popular with those responsible for spending money’ and ‘embrace a targeted set of activities with a clear aim (and hence cost), and hence accountability [that] can be maximized.’ This allows, they argue, limited time-horizons for spending the budget and the achievement of targets allow a long-term commitment to be circumvented or even negated altogether. This ‘fits neatly into the short-term time-frames that politicians inhabit’ they claim [p.98].

A ‘systemic inquiry’ approach can be seen as a form of antidote to living in a ‘projectified world’. Systemic inquiry is first and foremost a means to engage with uncertainty, or in the language of ‘wicked problems’, a way of acting where the problem is to know what the problem is.

Systemic inquiry is developing as a practical approach capable of (Ison 2010 pp. 243-44):
1. understanding situations in context (both current and historical);
2. appreciating multiple stakeholders and thus perspectives;
3. addressing and clarifying questions of purpose;
4. distinguishing what, how, and why, and clarifying when it is appropriate to address each;
5. facilitating action that is purposeful and which can be judged as systemically desirable and/or culturally feasible;
6. developing a means to orchestrate understandings and practices across space and time in a manner that continues to address social concerns when it is unclear at the start as to what would constitute an improvement (i.e., to adaptively manage a co-evolutionary dynamic);
7. institutionalising on-going use of the approach in a manner that does not trivialize and instrumentalise the premises on which it is built.

Ison (ibid) notes that ‘it is not the approach alone that is important but how it is enacted by a user in context specific ways’. Systemic inquiry is iterative and ends when those involved decide to end it.

Soft systems methodology (SSM; Checkland & Poulter 2006) was employed as part of this systemic inquiry with the intention of moving towards more ‘joined-up’ government research and development for addressing complex policy issues (APSC 2007). For example, climate change adaptation will require the coordination and cooperation of wide ranging interests and research activities to comprehensively understand the impacts of climate change and take timely and appropriate action in realising a low carbon economy and society.
In Chapter 7, the final analysis chapter, the different research strands are drawn together. This chapter outlines the strategic opportunities for FFSR within DPI, and beyond, based on building and exploiting Systems capabilities. It also outlines how the practical application of Systems approaches within FFSRD can be supported within a ‘systemic framework of theory and praxis, including possible methods and techniques’.

Some of the main elements of a second phase of the research relating to CCA are outlined in Chapter 8. A second phase is, of course, subject to ongoing funding. An undertaking by both parties was that Monash staff would collaborate with DPI in the preparation of at least one external funding proposal during the year such as an ARC Linkage Grant. In Chapter 8 some details are given of an ARC Linkage grant currently under construction for submission through Monash University in October 2010.
Chapter 2 Appreciating initial starting conditions 1: exploring FFSR managers perceptions of issues, and understandings and experiences of Systems

2.1. Engaging with FFSR Division managers

A series of nominally 30 minute interviews were held with 20 DPI managers from FFSR Division in the middle of 2009. In practice interviews ranged from 30 to 75 minutes. We undertook these interviews as background to workshop design, particularly in terms of elucidating how managers perceived the main issues that they and DPI had to contend with and how, if at all they understood Systems as an intellectual and practice domain. Interview questions included: [Past] 1. How did you come to be in DPI? 2. Tell me about any experience that you have with systems thinking approaches; [Present] 3. From your perspective and in the context of your role in the organisation, what are the major uncertainties that DPI faces at present? [Future] 4. What do you think will be the most significant contribution that DPI makes to Climate Change adaptation going forward? [In closing] 5. Is there something that I haven’t asked that you think I should have asked?

As those responsible for designing and facilitating a one day workshop we wished to make it as personally and professionally rewarding as possible as well as making it as relevant to the needs of DPI, and FFSR Division as possible. Consequently a workshop on systems thinking and practice was held with 23 senior staff of FFSR on 6th August 2009 (Box 2.1). The workshop design was based on an exploration of significant issues faced by FFSR senior staff as elicited through interviews with those staff who were invited to the workshop.

<table>
<thead>
<tr>
<th>Box 2.1. Workshop on Systems Thinking Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FFSR Division Managers</strong></td>
</tr>
<tr>
<td>Thursday 6th August, 2009</td>
</tr>
<tr>
<td>12.30-16.30</td>
</tr>
<tr>
<td>Metropole Hotel</td>
</tr>
<tr>
<td>44 Brunswick St</td>
</tr>
<tr>
<td>Fitzroy</td>
</tr>
<tr>
<td>1. Scene setting – Graham Mitchell AO</td>
</tr>
<tr>
<td>2. ‘Mirroring back’ your perspectives and issues</td>
</tr>
<tr>
<td>a. The design for the session</td>
</tr>
<tr>
<td>b. Perspectives and challenges for FFSR</td>
</tr>
<tr>
<td>3. The nature of the situations you have to understand, research, manage, change?</td>
</tr>
<tr>
<td>4. Systems thinking and practices</td>
</tr>
<tr>
<td>a. Situating your experiences in different lineages</td>
</tr>
<tr>
<td>b. Techniques and concepts</td>
</tr>
<tr>
<td>5. Opportunity for using systems approaches in different stages of the project cycle</td>
</tr>
<tr>
<td>6. Strategic and practical implications for FFSR (DPI)?</td>
</tr>
<tr>
<td>7. Closing remarks</td>
</tr>
</tbody>
</table>

N.B The workshop is designed as a sequence of interactive and short presentational sessions.

Figure 2.1 details the main ‘design considerations’ that managers considered important for the planned workshop. These data can also be regarded as a proxy for what managers regarded as important for the ‘systems science’ program within DPI.
Your 'design' criteria

- I spend a lot of time wading through management ****. It's difficult to move from the minutiae of budgets to talk about the more abstract big picture. I want to climb out of this and think in big picture terms. I'm hoping that ST will help here.

- I don't need to know the details of ST approaches, but I need frameworks that will allow me to have conversations with researchers.

- To some people, ST can look pretty dry. Spaghetti diagrams can be daunting.

- I'm yet to see a government department do strategy really well. There is not a lot of skill or expertise in foresight and scenario approaches to strategy.

- We need to get beyond the idea that "ST is for CC response".

- Previous presentations have been bloody awful. [Consequently] senior management doesn't understand the value of systems thinking.

- We often over promise on what we can deliver. Is our product "farming systems"? If so, what will they look like and when will they be delivered? Or is our product research relating to future farming that is carried out using systems approaches?

- I'm hoping that ST might provide tools to understand what might happen

- The context for the day needs to be set well-bring the relevance of ST back to issues faced by the agricultural industry

- Our focus has been on building tools, rather than thinking about the theory behind what we are doing. Our approach is technology focused and based on "pragmatic engagement".

- There is a high degree of subjectivity involved in the ways that competing needs are dealt with at present-it would be nice to have an approach that took out some of the subjectivity.

- Most people won't know what the hell it [ST] is all about. You need to give an insight into why this is important.

Figure 2.1 Systems workshop design criteria elicited from interviews with FFSR Division (DPI) managers. ST = systems thinking.

The interviews surfaced a broad range of issues, many of which might be best regarded as 'wicked problems' that would only be amenable to 'improvement' (as opposed to 'solving') by use of Systems approaches. Some background on 'wicked problems' is given in Box 2.2. The interviews also demonstrated that with FFSRD there was clearly a range of encounters with Systems as a field of thinking and practice (Figure 2.1).
Box 2.2 ‘Wicked problems’

Rittel and Webber first coined the terms ‘wicked’ and ‘tame problems’ Their paper, published in Policy Sciences 4 (1973), 155-169, was originally presented to the Panel on Policy Sciences, American Association for the Advancement of Science, Boston, December 1969. Wicked problems are usually characterized as:

- where there is no definitive formulation of a wicked problem.
- not having any stopping rule.
- when solutions are not true-or-false, but better or worse.
- having no immediate and no ultimate test of a solution
- being essentially unique.
- needing to be considered as a symptom of another problem.

Tame problems, in contrast:

- have a relatively well-defined and stable problem statement.
- have a definite stopping point, i.e. we know what the solution is or when a solution is reached.
- have a solution which can be objectively evaluated as being right or wrong.
- belong to a class of similar problems which can be solved in a similar manner.
- have solutions which can be tried and abandoned

Rittel and Webber argued that: ‘There seems to be a growing realization that a weak strut in the professional’s support system lies at the juncture where goal-formulation, problem-definition and equity issues meet’. Also that: ‘Goal-finding (central to planning) is turning out to be an extraordinarily obstinate task’.

2.2 The nature of the issues confronting DPI and FFSRD managers

A series of 51 questions that attempt to capture some of the significant issues faced by FFSR were developed from the interviews (see below). These questions were developed from views expressed during the pre-workshop interviews and encompass views from all participants in that process and on this basis, contain some overlap.

1. How can FFSR best achieve the broad strategic aim of supporting the development of farming systems that are more productive through increased flexibility in the face of temperature increase, decrease in water availability and greater climatic variability?
2. How can radical change to Victoria’s farming industries be achieved without ‘crashing the system’?
3. How can FFSR make on-farm and on-site stakeholder engagement more effective, through promoting dialogue and developing greater understanding?
4. How can FFSR help on-farm and regional community stakeholders in Victoria’s agricultural industries develop deeper understanding of the ‘bigger picture’ in relation to adapting to emerging circumstances (climate-driven or otherwise)?
5. How can FFSR ensure that R&D ‘lands in the right place’ to inform thinking and policy on big issues?
6. How should we assess and prioritise R&D to ensure that it really does make a difference?
7. What is the role of government in applied research in the food area?
8. How can FFSR retain and attract appropriately skilled researchers and innovators?
9. How can FFSR develop greater rigour in project development and management?
10. How can the way that FFSR’s portfolio of projects fits together be best understood, in order to ensure that they work together?
11. How can FFSR’s research managers build more effective bridges between disciplines?
12. How can FFSR carry out effective research in an environment where rapid changes mean that basic foundational assumptions no longer apply?
13. How can FFSR contribute to ensuring that policy is formulated on the basis of appropriate evidence?
14. How can FFSR contribute to appreciation of both the upsides and downsides of various policy options to support CC adaptation?
15. How can FFSR expand understanding of ‘Victoria’s natural advantage’ in choosing the most appropriate enabling, core sciences to support and develop?
16. How can FFSR develop a more systematic approach to making decisions on research direction?
17. How can FFSR integrate activity systems across portfolios, and hence realise greater synergy between projects that are located in different portfolios?
18. How can FFSR identify leverage points that provide 80 percent benefit with 20 percent effort?
19. How can FFSR develop a more comprehensive understanding of the product and purpose of its work?
20. How can FFSR pre-empt changes in political forces (e.g. animal welfare concerns) that might prevent industries from working as they do at present?
21. How can FFSR better match understanding of farm-level economics with the science that is being developed?
22. How can FFSR better manage multiple, diverse, interacting projects each with their own objectives?
23. How can FFSR best deal with portfolios of projects in a strategic manner?
24. How can FFSR most effectively assess options for land use, and where best to carry out agricultural activities?
25. How can FFSR continue to deliver benefits in the face of resource uncertainty and constraints on availability of human capital?
26. How can FFSR best carry out research that integrates the triple bottom lines via multi-disciplinary teams?
27. How can FFSR best approach the process of designing projects in a rigorous way?
28. How can FFSR respond to policy conflicts between CC adaptation and mitigation (some adaptation approaches may have negative impacts on mitigation efforts)?
29. How can FFSR most effectively support Victorian agriculture industries’ adaptation to the future operating environment (of which CC is an overlay)?
30. How can FFSR improve its collective assumption testing and development of consensus on assumptions?
31. How can FFSR assess the public-private benefit ratio in relation to a given project?
32. How can FFSR contribute to reduction of environmental risk, while maintaining productivity and avoiding social problems, in the face of ever-decreasing research investment?
33. How can FFSR’s operations be better understood in terms of ‘supply chain efficiency’?
34. How should we understand what it is that FFSR produces?
35. How can we best collect information and monitor performance?
36. How can establishment of policy direction and the management of research capability (and human resources in general) be approached in a more integrated way?
37. How can FFSR maintain relevance in the face of civilizational challenges perhaps best characterised by [Joseph Tainter’s] metaphors of a runaway train and house of cards?
38. How might FFSR utilise knowledge of and expertise in understanding the carbon cycle as a basis for managing CC-related research?
39. How can the ability to “tell the story” about why FFSR does what it does, how it fits together and how it contributes be disseminated throughout the division (this is already in place from levels 1-3)?
40. How can FFSR’s research be best aligned with overall DPI strategy?
41. How can FFSR best inform policy makers of the type of science that needs to be done to support policy priorities?
42. How can FFSR best approach its activities in the face of year-on-year ‘productivity cuts’ of 5% (5% increase in productivity with same funding)?
43. How can FFSR help horticultural industries adapt to CC?
44. How can FFSR understand the broader impacts associated with elevated CO2 impact on grain growth?
45. How can FFSR better understand what the future might look like?
46. What new capacity and expertise might FFSR need to deal with the complex, cross-sectoral challenges facing agriculture in Victoria?
47. How can FFSR’s project logics best be integrated with DPI’s 4 year and 20 year strategies?
48. How can a perceived disconnect between bottom up and top down approaches to dealing with major challenges be approached in FFSR?
49. How can we in FFSR best navigate the rationalisation process taking place in relation to the National R&D Framework, in order to understand ‘who should do what’, and what our role should be?
50. What is needed to allow FFSR to work collaboratively with the whole range of players, all with their own interests and goals, in relation to animal welfare?
51. How can FFSR get best advantage from the FACE facility as a basis for contributing to CC adaptation?

The interviews also surfaced significant systemic issues that could be depicted, and thus better understood, using particular systems approaches. One example was the systemic implications of innovations led by DPI in introducing Friesian Holstein’s into the Victorian dairy herd (Figure 2.2). It was possible to explore this issue using causal loop modelling (arising from the Systems Dynamics lineage – see Box 2.3 and below). In this example a seemingly simple technological improvement – introducing a new breed, had unintended consequences in relation to overall farm and thus livelihood, viability.

Example 2: Holstein cows for dairy productivity—"seeking the wrong goal"?

![Figure 2.2 Systems dynamics model of the unintended consequences of a technological innovation (investment in Holstein cattle) based on interviews with FFSRD managers.](image-url)
During the workshop, causal loop mapping (also known as influence mapping) was introduced as one Systems technique that might be appropriate for exploring some of the issues that FFSR faces. The ‘arms race’ metaphor, which is a pattern common to a range of phenomena, including pest management, was used to introduce the technique. Further details on the technique are provided in Box 2.3.

**Box 2.3. Causal Loop Mapping (CLM) or “influence mapping”**

Example 1: escalation in pesticide use (“arms race” metaphor)

![Diagram of Causal Loop Mapping](image)

Figure 2.3 An example of the ‘arms race’ metaphor which is a common pattern applying to phenomena and thus a key aspects of systemic science within the Systems Dynamics tradition of causal loop modelling.

Causal Loop Mapping is a technique for exploring (individually or in groups) and telling stories about causality.

In particular, it encourages a shift from thinking in terms of linear causality (A influences B) to circular causality (A influences B which also influences A), introducing the key systems concept of feedback.

The important system elements in CLM are variable parameters (parameters that can “go up or down”). Constant parameters may also be indicated, but are of peripheral interest only.

A central systems idea behind this technique is that structure influences (and in some cases determines) behaviour. CLM can be used to better understand the structures underlying historically observed behaviour, or for anticipating future behaviours that may result from proposed structures.

CLM might be thought of as a “mud-mapping” technique often used in preparation for more rigorous system dynamics or stock and flow modelling (but often sufficient in its own right also).

The system dynamics lineage is generally oriented towards more comprehensive understanding of the exterior “world out there” that the systems practitioner encounters. In this sense it is an important complement to lineages that surface the interior worlds of systems participants and practitioners, through which the exterior world is experienced.

The CLM technique introduced here is one way of proceeding; various refinements can be introduced to better accommodate subtleties of situations.

Source: Josh Floyd, 2009.
Examples 1 and 2 demonstrate how particular systems approaches could be practically employed either prospectively, i.e. as part of project development, or ex poste, i.e., for learning and evaluation.

During the workshop, participants identified other situations where this approach might be practically employed to look at the systemic implications of what superficially seem to be simple technological developments e.g. new genetically modified grassland plants.

2.2.1 Comments from participants on 51 issues for FFSR Division

Those present were asked to reflect on the 51 issues and to provide an interpretation of what, collectively, they meant for FFSR Division. Participants were asked to read the handout with the 51 questions and to have a conversation with the people on their table to help them make sense of the implications of this list of issues. They were then asked what the key implication was that this conversation had brought up and then to write down a personal response on a post-it note. The following comments were provided:

- Division should focus on developing a more effective and efficient “R&D” System due to funding pressures and a need to make a difference.
- Surprising focus on internal process(es) (vs outcomes/outputs) – may not be surprising depending on specific question asked.
- “Call for Help” re prioritization of activities and objectives. [We] could easily be overwhelmed.
- No surprises! (really) Although “profitable farming enterprises should be more prominent.”
- Duplication [amongst the 51 points] – similar/same/overlapping issues expressed differently.
- Lot of questions reflect where we are in the change cycle – just get the current structure bedded down.
- There are a number of good answers to each question, but perhaps no “right” answer.
- Internal focus on process and relationships.
- Are issues wicked or tame? Do you use the same approach?
- Insecurity
- How to make a difference? Can we?
- Different answers if asked scientists/technicians etc??
- Unsure of the future . . . e.g. Climate Change
- Internal focus: - interaction/procedures/policy/delivery on policy/rationalism.

The outcomes of the workshop were sent to FFSRD managers but we are not aware of any follow-up. This raises some important questions. To be taken up by FFSRD does Systems Thinking and Systemic Science have to be ‘projectified’ and remain within named project boundaries, or can it be picked up as a cross cutting innovation across all projects?

A second issue emerging was the inward looking nature of many of the concerns. This suggests that Systems approaches could be employed to become more outward looking, to build stakeholding amongst key constituencies.

A third theme to emerge from this part of our inquiry was the adequacy, or not, of the current project management model and the way the project cycle was being implemented. This issue is taken up below.
2.3 Manager’s engagement with the Systems intellectual field

Interview findings indicated a range of expectations for or disappointments with ST/SP as indicated by the following quotes:

- Previous presentations have been bloody awful. [Consequentially] senior management doesn’t understand the value of systems thinking.
- We need to get beyond the idea that “ST is for CC response”.
- The context for the day needs to be set well—bring the relevance of ST back to issues faced by the agricultural industry.
- Providing appropriate context for the importance of ST is vital. There are systems thinking sceptics.
- I’m keen to see ST used to add value and not as an end in itself. It should be a means to an end—we need to keep bringing it back to practical implications.
- I’m hoping that ST might provide tools to understand what might happen.
- Our focus has been on building tools, rather than thinking about the theory behind what we are doing. Our approach is technology focused and based on “pragmatic engagement”.
- I spend a lot of time wading through management crap. It’s difficult to move from the minutiae of budgets to talk about the more abstract big picture. I want to climb out of this and think in big picture terms. I’m hoping that ST will help here.
- I’m hoping ST will provide me with the set of tools that I need to help with meeting my responsibilities.
- There is a high degree of subjectivity involved in the ways that competing needs are dealt with at present—it would be nice to have an approach that took out some of the subjectivity.
- I don’t need to know the details of ST approaches, but I need frameworks that will allow me to have conversations with researchers.
- ST approaches are not front of mind in the FFSR division.
- There was a modelling group in the 1980s that tried to get the “correct model” for systems that it was looking at. It was thwarted in this aim, and ultimately shut down.
- We often over promise on what we can deliver. Is our product “farming systems”? If so, what will they look like and when will they be delivered? Or is our product research relating to future farming that is carried out using systems approaches?
- To some people, ST can look pretty dry. Spaghetti diagrams can be daunting.
- I’m yet to see a government department do strategy really well. There is not a lot of skill or expertise in foresight and scenario approaches to strategy.
- Most people won’t know what the hell it [ST] is all about. You need to give an insight into why this is important. Some people might switch on because it is “logic based”; others need to know what ST is at the start. What are the core concepts? What do people need to know? What unites all the diverse approaches to ST? What is the essence? What does it mean? Use a case study; tell a story.
- When we held a series of 3 or 4 meetings to scope the Farming Systems Research Project, we had a new cast of scientists who attended each meeting, and there was no common understanding of scope or approach to systems research. This was a real problem. Most biological researchers don’t understand the social or financial dimensions of their work. We need to get everyone to understand that they only contribute part of the knowledge. A program to get people onto a common level of thinking is necessary to make progress on ST. People don’t always “hear the story” that other have put significant effort into.
- I’ve been exposed to a few seminars [on ST], but it seems very abstract. I guess I don’t have the right end of the stick…I’m not so analytical.
- I don’t believe that many people have a concept of ST in DPI.
• Scientists who are quite innovative will take ST and apply it. But a good portion will not. It’s a matter of culture change rather than taking up a new tool. In my heart I’d like us to be a learning organisation, but I don’t think that we are.

• I want more than just a technical discussion about techniques for ST&P. I want the broad philosophy behind it, the theory—I want to know conceptually how this can help.

• An interest in ST should not just be academic, it has to inform policy.

• Workshops on ST will be most effective if they are based on specific project contexts.

• As a capability-building project, the current ST workshops have a limited life. This needs to articulate into a formalised qualification for staff, perhaps run through a university. Training should mature in this direction.

• I hear a lot about ST—“it’s we need to head”, “it’s a great tool.” Two years ago I attended a presentation by a colleague on ST. I was lost from the first slide. The presentation wasn’t engaging and there were too many diagrams. It’s a bit scary. The presentation was supposed to be an overview, but it was not at the right level and I was left feeling overwhelmed. I didn’t get an overview of the area. It left me feeling I had no idea, and that ST was too big to tackle. I’m not exactly sure what it is, maybe I do this, but I don’t know. How do we use it? What is the hype all about? Is it worth pursuing? I want to understand the language.

Systems, as an intellectual field, is often poorly understood. It is actually a more substantial field with a richer legacy than is usually appreciated. Figures 2.3 and 2.4 exemplify some of the key actors and relationships within the Systems field; Figure 2.4 is one depiction of the field showing how particular lineages of systems practice/approaches have developed. This figure, from Ison (2010) has been annotated to show how individuals associated with the DPI ‘systemic science’ initiative can be linked to this schema.

Figure 2.3 Some of the ‘names’ within the Systems intellectual field – from left to right Ilya Prigogine; Ross Ashby; Ludwig von Bertalanffy; Gregory Bateson; Margaret Mead; Donella Meadows, Humberto Maturana; Jay Forrester; Howard Odum.
Experience has shown that it does not pay to assume that individuals who claim to know something about Systems actually appreciate the scope and range of key theories, tools, techniques, methods and methodologies associated with the field. It was considered important therefore, as part of the new ‘Systems’ initiative in DPI, that the perspectives and understandings held by the FFSR management group in relation to: (i) the nature of the main issues confronting DPI in general and FFSR in particular, and (ii) how Systems was understood, be appreciated.

In the interviews several respondents raised concern about the use of spaghetti diagrams. Unfortunately some equate these diagrams with THE systems approach. This of course is an inaccurate depiction. Individuals and the media seem unable to deal with the systemic complexity encompassed in a large systems dynamics causal loop model as a recent cause celebre demonstrated\(^3\). At one level this is understandable. On the other hand, as we have known for some time from our 30+ years of teaching Systems diagramming techniques to Open University (UK) Systems students, a diagram produced as part of an inquiry/learning process is not the same as one used for communication purposes. The key issue with respect to Systems diagramming and modelling is: who participates (i.e., who learns) in the process of developing the model?

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\(^3\) See [http://rayison.blogspot.com/2010/05/general-stanley-mccrystal-and.html](http://rayison.blogspot.com/2010/05/general-stanley-mccrystal-and.html)
Figure 2.1. A model of some of the different influences that have shaped the lineages from which the key players in recent DPI systems activity are located within the model schema in relation to their main influences. (Source: based on Ison 2010).
2.4 Reflections on the workshop and suggested follow-up actions

The following list of reflections on the workshop and its findings offered by those present indicate an overall positive outcome as well as considerable enthusiasm to better deploy Systems in pursuing FFSRDs' mission. The reflections offered included:

- Reflections from today: insightful and useful.
- FFSR could use systems thinking to inform FFSR business strategy and investment.
- Division should focus on developing a more effective and efficient “R&D” System due to funding pressures and a need to make a difference.
- Should be done – incorporate Systems approaches in program development.
- Need for an efficient R&D “System.”
- Worthwhile! Well done.
- Reflection. We have the basis to approach things systemically in FFSR – we now need to build on this.
- Systems thinking techniques should be implemented by project development teams to ensure the appropriate scope and nature of our work.
- Reflection. There are some tools and techniques I am unaware of that I will need to investigate!
- Duplication – similar/same/overlapping issues expressed differently.
- Lot of questions reflect where we are in the change cycle – just get the current structure bedded down.
- There are a number of good answers to each question, but perhaps no “right” answer.
- Internal focus on process and relationships.
- Are issues wicked or tame? Do you use the same approach?
- Insecurity
- How to make a difference? Can we . . .
- Different answers if asked scientists/technicians etc??
- Unsure of the future . . . e.g., Climate Change
- Internal focus: - interaction/procedures/policy/delivery on policy/rationalism.
- How do we decide what we are going to do.
- Value of systems thinking approach (particularly visual mapping approach) to project development of project logic development.
- Ensure impact (position, collaborate, inter-disciplinary rationalise) engage stakeholders.
- Great session – wish it was longer and involved more exercises. Got value out of the doing.
- Loop mapping should be done by project/concept development teams because a wholistic viewpoint, foreseeing ‘issues’ may come to light.
- I think I am now a bit more on the page with respect to what systems thinking is. Challenge now is to apply in course of my job.
- FFSR. Clarify process by which DPI strategy and policy are being linked to our R&D investment decisions.
- FFSR relationship with policy.
- Relevance/role of FFSR direction and demonstration of value.
- Direction – how robust are processes. Deployment/methodology - how do we improve processes?
- Demonstration – what is value and to who (how to measure).
- ST is as much about the context for our thinking as process.
- An influence map for key projects should be done by KPM/RM’s to provide a whole picture of research for FFSR staff.
- How do we decide what we are going to do and do it efficiently and effectively.
What I think should be done by FFSR? We need to better understand what Ray Ison will be doing for FFSR and how we best access his expertise.

Get Ray to help develop the narratives for the key projects and help identify the boundaries for each and the connectively. Reflection there was some real gems for me today – some alignment with what our Dep. Sec is driving for.

A consistent theme emerging from the interviews and reflections was that of project management and the project cycle. Figure 2.5 depicts the project model employed by the DPI at the time of the workshop.

Figure 2.5 The four phase project management model used within the DPI.

It is worth noting that this model is systematic, not systemic (see the figure on the cover to this report) and that it is likely that FFSRD, and DPI more generally, would find value in developing this model to reflect a set of practices that were systemic, rather than systematic. How this might be done and how systems approaches could be deployed is taken up in Chapter 7.
Chapter 3  Appreciating initial starting conditions 2: Climate change adaptation research

3.1 Research setting

The Victorian government has committed itself to ‘a statewide Climate Change Adaptation Plan, which will be required by the Climate Change Bill’. Through this ‘the Government will work with the community to assess, at regular intervals, the risks to these key sectors [building and critical infrastructure, agriculture and food systems, health care, emergency services, etc] and the priorities for climate change action across the State.’ This, it is claimed, ‘will help to ensure climate change is built into the decision-making of government across the board’ (Victorian Government 2010b, p. 23). It is appropriate to consider this inquiry within this emerging, and rapidly changing context.

In its design this ‘inquiry’ has involved selected DPI staff and some of its government partners to build up a systemic appreciation of current DPI climate change adaptation research. In other words the research to date is exploratory in nature and designed to facilitate a second round of inquiry into how, if at all, systems approaches might usefully be incorporated into DPI’s future CCA research repertoire.

Soft systems methodology (SSM; Checkland & Poulter 2006) was employed as part of this systemic inquiry with the intention of moving towards more ‘joined-up’ government research and development for addressing complex or ‘wicked’ policy issues (APSC 2007). Climate change adaptation will require the coordination and cooperation of wide ranging interests and research activities to comprehensively understand the impacts of climate change and take timely and appropriate action in realising a low carbon economy and society.

This chapter documents the background to the inquiry and the methodology. Chapter 5 discusses preliminary findings about how CCA research has taken place in the DPI, initially from the perspective of research managers and some key stakeholders in other areas of government. The research inquiry has been conducted using ethnographic methods of interview, document analysis and participant observation. The study takes a view of CCA research as a ‘system of inquiry’ ultimately for the purpose of directing research management and practice towards improved performance under the dynamic circumstances of climate change. It does so from the perspective of those operating within the situation and will contribute to developing a systemic and adaptive governance framework for climate change adaptation research and practice.

An ultimate aim, following this initial scoping phase, is to develop a systemic framework of theory and praxis (theory-informed practical action), including possible methods and techniques, to assess potential climate change impacts and adaptation actions in

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“How can FFSR better understand how its portfolio of key projects fit together as a whole?” (FFSR Manager)

“There has never been a project for designing projects that integrate multiple disciplines.” (FFSR Manager)

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4 By systemic we mean something that has an appreciation of how it operates as a whole system through its integrated or articulated parts performing a function that means more than simply a sum of its parts. By adaptive we mean something that is responsive to changes in its environment such that it also maintains a sense of its distinction from the environment in which it operates as a self-organising intelligence.
agriculture and forestry systems at regional and state-wide levels. It was initially intended that the systemic framework would be tested in the Goulburn Broken region of Victoria, in a second round of the DPI Victorian Climate Change Adaptation Program (VCCAP). However, this next phase is now pending whilst the future of VCCAAP II is being determined. Meanwhile this analysis is designed to invite consideration by research managers and practitioners of what a future systemic and adaptive research governance framework for future CCA might look like. Our primary aspiration is to support the DPI in being as effective as possible in its future CCA research.

From this first phase of research a systemic and adaptive framework for governing CCA research with research practitioners is proposed. Initially our aims are to create awareness of possible opportunities and to open up ‘space’ for inquiry into alternative governance modes in which greater accommodation of difference and realisation of opportunity and innovation can be achieved. We explore the possibility of designing research that localises and expedites the transition from observation, through facilitation and design, to co-research with research beneficiaries. Our research is guided by the question of ‘who learns’ in the process of inquiry as critical to enabling the ability to respond in a climate changed world.

### 3.2 Aims

This report explores how CCA research management has taken place in the DPI. A key question addressed is whether a transformation of DPI-led CCA research towards more systemic and adaptive research management practices is systemically desirable and culturally feasible. The purpose of the research has been to identify opportunities, and learn lessons, in response to the question: Could future DPI CCA research potentially benefit from more ‘systemic framings’ and use of systems methodologies? It was also initiated to inform means of developing improved research capability in areas of learning and collaboration using Systems Thinking methodologies.

Systemic and adaptive approaches appear necessary in the face of intractable ‘wicked problems’ such as CCA (APSC 2007; Box 2.2). However there are constraints in realising that practice due to a narrow framing of research problems often from within single disciplines. For this reason, an initiative from within DPI supported by research directors sought to explore how management is cultivating systemic practices and to what extent systems methodologies can support timely and effective delivery of CCA research from within and across different programs and disciplinary areas.

### 3.3 Research Framework

The research inquiry has been implemented through a series of five interrelated activities that link research management practice to the wider context of CCA research activities (Figure 3.1). This forms the first phase of a larger agenda working towards an appreciation of research management practice as a purposeful human activity and form of systems practice (Ison 2010).
Figure 3.1 Process for investigating CCA research. This report concerns stages 1-3.

Chapters 3-5 report the first three activities on the context, framing and practice of research (Figure 3.1) and is directed at understanding how the climate change situation is being appreciated in practice primarily through the DPI’s CCA research program (VCCAP). The fourth and fifth activities are yet to be completed. They comprise reporting on the process followed to do the research and how it becomes appreciated within DPI and the wider community (4) as well as the development of a systemic and adaptive framework (systemic intervention analysis) for research practice in the DPI (5).

3.4 Methodology
The research has been set up as a Systemic Inquiry (Box 1.2), which is a form of research practice designed to engage with situations of complexity and uncertainty. SSM (Checkland and Scholes 1999) has been utilised within the inquiry process as a means to understand how CCA research management and practice takes place within the DPI. Supporting that methodology an ethnographic approach (Hammersley and Atkinson 2007) involving a mix of qualitative methods including semi-structured interviews, participant observations and document analysis has been employed. In this first phase of the inquiry, we use triangulation of the methods to understand differences across data sources and to make comparisons on how concepts of climate change impacts and adaptation are being realised in practice set against the global context and international, national and state policy responses (Figure 4.2).
Data were collected during a twelve month period between September 2009 and August 2010 whilst working from the DPI. One to two days a week were spent in the DPI Parkville offices. This included interacting with research staff and managers; meetings were attended, conversations held and participation in activities such as internal and external conferences, workshops, seminars and public forums. Observations were made and notes taken following these events and interactions to support understanding and analysis of DPI FFSR workplace activities as a ‘system of inquiry’. Data have been examined using a mix of analytical methods combining grounded theory (Strauss and Corbin 1998) and critical discourse analysis (Wodak and Meyer 2001) with three analyses of SSM (Checkland and Scholes 1999) to track and identify key themes in and across the various data sources (see Appendix 10.4 for details). In this case we examine framing or coherent stories and accounts through textual representations and interactions between documents, interviews and observations to understand how CCA research takes place within DPI and with some of its government partners.

A review of three international, national and state research policy documents was used to situate a nested hierarchy of CCA research guided by discourses of global responsibility at the international level, sustainability of development at the national level and securing economic and resources futures at the level of the state of Victoria. These documents were selected as leading CCA research ‘policy’ documents in the three spheres of governance at international, national and state levels of action. A nested hierarchy was imposed to elicit understanding that framed the drivers, constraints and limitations, and desired competencies and skills directing research activity in two DPI

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strategy documents. We used this hierarchy as a basis for considering how research mediates adaptation planning and action by looking at different constructions of knowledge need, conceptual models of research, valuing of such concepts and connections between research activities and changes on the ground, initially from the perspective of research management practice (Box 3.1).

### Box 3.1 Research management practice

Research management is a form of practice. Traditionally it involves aspects of program and project management. It also involves dealing with complex research areas as well as changing needs to manage different disciplines. Such complexity will place greater emphasis on skills for addressing and managing ‘research problems’ in which different knowledge disciplines intersect.

The Operations Research Society (UK) in 2003 devoted a special issue of its journal to intersecting concerns associated with: managing knowledge, organisational learning, intellectual capital and knowledge economics. It addressed cross-disciplinary approaches particularly involving ‘soft’ interpretative (cultural or motivational) science and ‘hard’ science engineering (technological) and relates these to the theory and practice of knowledge management. Within this framing research management practice is illuminated by a material view of practice as a social technology in which various “affordances and constraints” (Venters 2010, p. 161) govern or dictate how research management takes place. By viewing the production of knowledge as “construed out of available resources” (Zhu 2010, p. 173) a stronger emphasis can then be placed on how such processes can be better directed through purposeful design.

Research management practice is coming to integrate different sources of knowledge and their respective disciplines, theories and methodologies. Whereas traditionally research management has been seen as a simple task of ensuring efficient and timely delivery of goals there are areas in which managers are now having to frame and integrate research across disciplines and dealing with higher levels of uncertainty and contingency. Budget allocation and management is often a key aspect of practice. What is unclear is the extent to which research managers act with awareness of a general model of practice (Figure B3.3) which suggests that any from of practice entails a performance involving a practitioner, with a history, a framework of ideas or theories, choices to be made about the nature of situations, and deployments of methods or methodology (Ison 2010).

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6 DPI Future Farming Systems Research Future Farming: Productive, Competitive and Sustainable (Victorian Government 2008) and the DPI Agriculture and Fisheries Four Year Strategy 2009-2013 (Victorian Government 2009a) as sources of data on policy response and interviews with DPI, Policy and Strategy Group, DPCD and DSE staff as sources of data on research practice.

7 See also Journal of Knowledge Management, Research and Practice, [http://www.palgrave-journals.com/kmrp/index.html](http://www.palgrave-journals.com/kmrp/index.html)

8 If practitioners can see that knowledge is socially constructed then there is a better chance of realising the difficulties in conceptual integration across disciplines. There is not just an abstracted world out there for discovering in its underlying causes but one that is ‘made’ in the relation between ‘social’ and ‘natural’ things interacting. How resources are brought to bear on a particular problem or situation (rationalised in its social and cultural construction) and coordinated to address it (altering the framed issue by means of the epistemologies, methodological constructs and technologies which mediate its ‘knowability’) becomes part of the focus of learning and improving the situation.
A conceptual model which can be applied to many forms of practice (e.g. researching, policy making, leading etc) comprising a person thinking about a ‘real world situation’ in which a person or practitioner (P) (who may be the same as the person who is thinking) engaging with a situation (S) with a framework of ideas (F) and a method, M (Source: Ison, 2010, Chapter 3)

Thus what theory informs the practice of research and how it is relevant or how does it serve and support those in the practice of research management is a valid issue for inquiry.

The nature of this inquiry is qualitative. It examines the actual practice of research and research management from the perspectives of people involved as well as the directives and framings of research in the text of policy and research documents. It is a reflexive open ended inquiry rather than an objective testing of hypotheses. Therefore the data collected and analysed is not designed to be representative but provides a contextually valid account of the experiences and perspectives of people interviewed (Mason 1996; Patton 2002). It also offers an interpretation of documents and observations against those views expressed as a means to describe CCA research as a ‘system of inquiry’. The purpose is for reflection on the activities which constitute such a system, their purposeful design and whether they achieve what they set out to do. This analysis is not trying to understand independently of the context but to surface a range of perspectives exposing different views of CCA research practice and experience. Such a purpose requires adequate variation in viewpoints to generate a triangulated picture of the area of interest. The research team has purposefully selects its participants to represent difference in perspectives of CCA research. The approach is designed to create the grounds for inviting research participants and issue owners to reflect on the issues as a means for self-articulated improvement.

Purposeful sampling uses a different logic of research to quantitative methods such as random sampling (Patton 2002). Random sampling methods derive from statistical analysis using probability theory permitting confident generalisations based on a representative sample of the subjects or phenomena being studied. Where situations are less readily reduced to hypotheses of cause and effect, another sampling rationality is required. The purpose of probability based random sampling in quantitative research is to eliminate selectivity bias and strengthen the representativeness of findings (Patton 2002, p. 230). However things that might ‘bias’ the sample therefore providing a weakness in the generalisability of findings are precisely what qualitative sampling addresses. It aims to get behind the variation or resistance to generalisation from what occurs in reality.
Depending on the depth of analysis qualitative interviews need only a small number of participants; however the question still arises of how many interviews are sufficient for qualitative analysis. This is not something that can be generalised and although the number generally is assumed around 20-30 (Brown 2010) there is no steadfast rule or criteria for sufficient numbers. Some argue that a purposeful sample is exhausted when no new material emerges (Glaser and Strauss 1967). However there are other constraints with the accessibility of the sample and the time required to analyse qualitative data. It also depends on what others methods are being used to supplement qualitative interviews and the type of research question being addressed. In one approach mixed methods are increasingly being used in a qualitative context to triangulate different perspectives and overcome methodological bias of research findings (Tashakkori and Teddlie 2003). Ours was a purposive sample triangulated in the pool of CCA research managers in the DPI and stakeholders in other areas of government along with documents and observations to elucidate different perspectives of CCA research management and practice as a basis for further discussion of CCA research as a ‘system of inquiry’.

The advantages of doing qualitative work are it gives accounts of experience and understanding by permitting flexibility and allowing the process to evolve by decreasing the distance between researchers and subject (Brown 2010). It generates richer data that enables insights to be gained from small numbers and is a more interesting account that is more reliable because of its reflexivity (Brown 2010, p. 241). Reflexivity reviews prior assumptions in the process of interpretation to offer an authentic account of participants’ experiences. In open systems or non experimental situations, qualitative methods are a valid means for establishing some plausibility in understanding. Often methods of triangulation are used to provide validity to findings where different perspectives converge on the same interpretation (Hammersley and Atkinson 2007; Blaikie 1991). However triangulation can also be used to provide different view points of the same apparent phenomena to reveal underlying assumptions and dominant constructions of an issue (Seale 1999). This kind of analysis can be useful for where a problem, as it has been defined, defies solution such as the intractable nature of climate change or resource management conflicts.

3.4.1 Process

As part of the scoping and preparatory work for our inquiry, a set of interviews and workshops were conducted, initially gathering viewpoints of Future Farming Systems Research (FFSR) managers on how they might benefit from the research (see Chapter 2). Some of the views expressed are shown as boxed quotes throughout this report to situate executive perspectives within these findings. Furthermore two workshops were held with the project initiation team comprising key staff from the DPI, Monash University researchers and other systems practitioners demonstrating how systems thinking techniques could support an inquiry into CCA research.

The workshop with FFSR managers represented research as an ‘open learning’ system which is set within the scientific, social and political context that shapes the way research is conducted. Such a view invites the question of how researchers engage stakeholders as joint decision-makers as distinct from a ‘delivery’ relationship between research providers and recipients of services. In order to view research as a learning process those facilitating the workshop noted the need to build the idea of learning in a common context and understand what formal mechanisms are required to contribute to learning in a public policy context. The workshop presented a model of a viable learning system as not bounded by relationships but opened by them such that feedback readily flows between and is reflected upon as part of the management process (see Chapter 7).
This reflection has supported DPI in asking how things could be done differently. A small research team led by Victor Sposito, Rob Faggian and Ray Ison has designed and implemented this project overseeing key stages of its development. Data collection and analysis has been completed by Andrea Grant in consultation with the research team at key stages. It was initially decided that a set of interviews be conducted, analysed and reflected upon prior to commencing a second cycle of research to reflect upon initial findings in dialogue with research participants. This first phase of the research was conducted with a view to continuation; a second iteration was envisaged that would connect up the findings of the research with future practice design in a way that seemingly has not been previously done within the DPI.

A set of names was provided by members of the research team of people who have been involved in CCA research and were believed could provide different perspectives of the issues. Six people out of a pool of approximately 320 (160 researchers and 160 administration, some researchers are also research managers) staff involved in Future Farming Systems Research were interviewed. An additional three people were interviewed from other areas of the DPI as research stakeholders from Farm Services Victoria (3) and the Policy and Strategy Group (1) as well as three people from other areas of government from the Department of Planning and Community Development (2) and the Department of Sustainability & Environment (1). Thus we had an even number of internal and external perspectives of FFSR DPI CCA research. This generated a view of the group in relation to others rather than a view of the levelled out representative sample of DPI research teams. It builds a picture of the FFSR CCA team in relation to others as an organisational unit. This was designed as the first phase of interviews to surface different perspectives of CCA research as a basis for reflection and further discussion with DPI staff and others with a stakeholding in future farming systems CCA research activities. In all 12 interviews were conducted with 13 people.

3.4.2 Approach

Use of SSM within a Systemic Inquiry provides for the possibility of being able to articulate systemically desirable and culturally feasible change with research beneficiaries (Checkland and Poulter 2006, pp: 56, 58; Checkland 1985). But in this first phase we have worked with research management practitioners and other government stakeholders to begin to elucidate what constitutes systemically desirable change. Our initial analysis is based on observations and descriptions of what practitioners do. Our interpretation of these activities is based on an analysis of the different core activities (discourses) and boundary issues (framings) evident in the data collected through participants’ interviews, research publications and our observations within the DPI. We recognise our description of a ‘CCA researching system’ as a judgement in which different understandings will emerge from the perspective of those differently situated within the situation.

“The term ‘system’ is a convenient artefact often used to refer to a set of operations and relationships that have some specific outcome. It is when such systems are judged to be problematic or failing to achieve the desired outcome that they become the focus of a planned intervention.” (Ison and Russell, 2000, p. 209)

"We need a common view about 'systems' to communicate both internally and externally.‖ (FFSR Manager)

Following Ison and Russell (2000), our description of bringing a view of a system into existence or naming a system of CCA research, develops on the key aspects which soft systems research undertakes as a first order process of observation. There are four relevant components for understanding such a process: the tasks; the first order
observation of the system in practice; the necessary skills required for illuminating the system; and the potential pitfalls to avoid. Ison and Russell’s model is a comprehensive guide and it is noted that not all of its elements have been realised in this research (Appendix 10.6). Rather this research begins an inquiry process recognising the importance of learning from the practice of implementing theory.

There are four main points we take as critical components for effecting change in the way CCA research takes place. We defined our task as:

- generating a ‘system’ which has been determined by the main issues of concern to the key stakeholders;
- where the observation of the system is determined by the ‘problem’ not the problem being determined by the system;
- requiring the ability to successfully invite participants to offer narrative data via social technologies (e.g. semi-structured interviews; focus groups), and
- avoiding the pitfall of easily quantifiable data being judged as superior to less easily quantifiable data (e.g. value statements; emotional responses).

A systemic intervention is an action designed and developed with stakeholders in the research. Initially, it requires that we develop a systemic appreciation, which is an experiential understanding of how a ‘system of interest’ operates. Once this understanding is attained the researchers reflect back their findings about what it is that they witnessed as a ‘system’ to research participants and other stakeholders in the research. This provides the basis for discussion to flow and agreement to be realised on the key characteristics of an ‘adaptive system of interest’. It is a dialogic mode of inquiry that uses findings as a device for opening up discussion as opposed to the delivery of research findings to a passive and uncritical recipient audience.

In developing a systemic appreciation, Checkland and Scholes’s (1999) three analyses for initiating a ‘Systemic Inquiry’ were employed for understanding the culture of the situation in which CCA research is practiced (Mingers 2000, p.741). These comprise (i) naming and exploring a particular problematic situation in which there is a desire for improvement; (ii) exploring the culture and practices in the situation in which the problem or issue is found; and (iii) recognising the political nature of the situation and thus the power relations in which the problem or issue is manifest. The following key questions were adapted from SSM to capture the three elements of the inquiry to guide the research (Figure 4.4; Mingers 2000, p.741).

1. How do participants ‘construct’ the problem of climate change, what is the context in which they are motivated to respond to climate change?
2. How is climate change research rewarded; what are the significant roles for climate change researchers?
3. How can we analyse the relational dynamics as evident in the types of influence different interests and groups have over climate change research?

Semi-structured interviews were used to elicit responses that could address the three key questions (see Appendix 10.5 for interview questions). This provided “a means of distinguishing essential differences between soft and hard methods” of inquiry and problem structuring (Rosenhead 1989 cited in Foote et al 2007, p. 645). In this situation we took soft methods to refer to interpretive aspects of understanding a problematic situation and hard methods to refer to the instrumental aspects of designing an intervention to act on a situation.
3.4.3 Analysis
Two types of analysis were used for mapping the dynamics of discourse between the wider context and policy response of key DPI documents and the practice of research. The documents were viewed as providing the ‘representative text’ capturing the logic behind practical action as an illustration of how research is directed by problem ‘structuring’ discourses in policy documents. Second, participant observations and semi-structured interviews elicited an understanding of research management and stakeholding as ‘social practice’ experienced in real world contexts. This approach to analysis enabled a means for considering how the ‘logical’ basis of policy direction interacted with the ‘cultural’ basis of research practice through the ‘discursive practice’ of research conceptualisation, e.g., through framing and metaphor (Hart and Lukeš 2007).

Documents were initially read and notes taken for analysis of the main discourses shaping research policy directions. During this process documents were summarised to a shortened version of the whole as a ‘proxy’ document where the focus was given to the first section of the documents in which their purpose and contents were framed. The three key documents representing the wider context of research and policy direction were
read and a set of notes taken on the discourses they engaged with. A more detailed analysis was conducted on two policy documents informing DPI research practice exploring the details of research policy drivers, constraints and competencies. These documents were examined to capture a view of the DPI activities shaped by the main goals or drivers of change, the particular constraints or limitations in realising them and the skills and competencies required in overcoming constraints and for increasing the potential for desired change.

**Box 3.2: Policy drivers, constraints and competencies**

Policies are rule systems that form part of the institutional framework. Guess and Farnham (2003) describe a framework as a set of theories or models where no single theory can work effectively to explain a policy problem (p. 12). Different theories and approaches for policy analysis come and go but they are often shaped by the substantive issue of the day, e.g., in relation to the ‘strong society’ or ‘welfare state’ of the 60s and 70s compared with ‘regulatory state’ of the 80s and 90s (Peters and Pierre 2006).

More recently a focus on policy change has generated an interest in institutions for developing a “broader and more inclusive understanding of what shapes and sustains public policy” (Peters and Pierre 2006, p. 4). Peters and Pierre (2006) suggest that social scientists are only just discovering “what practitioners [in public policy] have known for a long time”, that governing institutions and the actors within them are influential in “mitigat[ing] the impact of changes in the political leadership” (p. 4). In this case our framework for policy analysis includes drivers, constraints and competencies as not just seeking those forces underlying change, the constraints to realising change but also the set of skills required to manage such change. This enables our analysis to work into the spaces of the institutions of governing as well as the spaces in which policies and programs have effects.

Typically policy analysis focuses on drivers and constraints as a means of articulating a purpose for political intervention in some desired area of policy or program. As such a policy or program can be seen as a tool or technology for intervening on behaviours for some selected purpose of governing a population and its activities. However there are limits with this approach in directing ‘how to’ implement such activities to achieve their purpose.

Policies and programs usually provide direction but leave the means of implementation up to those charged with this responsibility. This can lead to failures in realising policy goals and objectives. Management theory and practice, on the other hand, does provide more prescriptive means of realising certain goals through development of particular skills and competencies in management practice. We find this a useful technique or social technology for enabling a better articulation of how government or governance might function or perform to produce desired outcomes. On this basis we have expanded our analysis of strategic policy documents to include drivers, constraints and competencies. We realise that the third element of our analysis might not be explicit in documents and therefore will focus analysis on unpacking discourses to locate possible areas that capture a sense of skills and competencies for implementing climate change adaptation research and policy and program development.

Twelve semi-structured interviews were conducted with research managers and stakeholders covering two lines of descriptive and reflective questions (Table 3.1). Descriptive questions asked participants to describe the situation in which they practiced while reflective questions sought a more considered response to open the possibility for critique of the situation in which CCA research was practiced. This method was applied to present a critical view of how practices and perceptions of CCA research may have
varied amongst the group of participants. Observations were recorded from 47 different conversations and events to provide support in the analysis of interviews and in respect of understanding how CCA research took place within the social practices of research staff and stakeholders.

The first nine of the twelve interviews were replayed and notes taken including verbatim summaries of thematic content. This provided a first pass of analysis for consideration by the research team, documented in an interim report. Following feedback from the research team a further three interviews were conducted. Interviews were later transcribed, analysed and mapped according to emergent themes capturing areas of difference in response to the interview questions. Transcripts were returned to participants so that they could review their comment and reflect on what was captured. They were invited to provide comment. None of the participants provided comment on the transcript, although three indicated that they would like to see how their comment appeared in the findings.

A detailed analysis was conducted on the full interview transcripts which provided for more rigour in the comparison of discourses across each of the interview questions giving rise to a more structured analysis of the interview context. During this analysis attention was paid to the differences between FFSR, wider internal DPI and external DPI perspectives as well as to different metaphors and framings used in response to the question themes using grounded theory methods of constant comparison (Strauss and Corbin 1998).

The two lines of questions, those designed to elicit descriptive and reflective comments from interviews were paired into sets to generate comparisons (Table 3.1). Analysis of the paired responses was then used to respond to the key research questions, corresponding to the three areas of systemic analysis: the problem situation, the social situation, and the political situation.

The findings are organised into key areas to compare differences evident in interview discussions and participants’ framings of CCA research. Reporting of the analysis in this way is intended to enable an appreciation of the ‘system’ within which people operated as managers of, and stakeholders in, research. This framing of the analysis is designed to recognise that people have different perspectives on their practice and to open up a discussion on areas of agreement and disagreement, for the purpose of defining a boundary for the system in focus.

| Table 3.1 Two types of question, as descriptive and reflective, asked during interview |
|---------------------------------|-----------------------------------------------|
| **Descriptive**                 | **Reflective**                               |
| 1. Role - what you do and who are your main stakeholders? | 2. Contribution – how able to make a contribution to climate change knowledge? |
| 3. Threat – what kind of threat do you think climate change poses to Victorians? | 4. Conceptualisation – what different ways climate change research is conceptualised? |
| 5. Difference – how can and for whom will climate change research make a difference? | 6. Valuation – what conceptualisations of climate change are valued by stakeholders? |
| 7. Grounded – what climate change research actually looks like on the ground? | 8. Linked-up – is research activity linked up in any way, and how? If not, why it fails to? |
| 9. Barriers – what barriers for research in making a difference on the ground? | 10. Other aspects - anything else you think is important to this discussion? |
Interview questions 3 & 4 provide a response to respond to how participants construct the problem of climate change and what context they are motivated to respond. Interviews questions 5 & 6 provide a response to the question on how research is rewarded and what are the significant roles for researchers. Interview questions, 1 & 2 and 7 & 8 provide a response to the question on the ‘relational dynamics’ in terms of influence that different types of groups and interests have on research.

The last two interviews questions form a view of the starting conditions for how a transformation of the CCA researching system might be designed by considering personal and professional barriers and areas of emphasis for change expressed by participants.

As a Systemic Inquiry our involvement in the sense-making activities of research management underlies our ability to interpret practice from the context in which it is experienced. Furthermore it raises an awareness of the issues of articulating research “need” and enabling a person to learn or discover something for themselves. We conceptualise our work within DPI as moving between different modes of research practice from observer to facilitator and co-researcher status (Figure 3.4). Observing activity and documenting it in a form that was informed by our particular theories and ways of knowing provides a device, potentially for the use of others, as a reification of what was observed. As facilitators we worked with those who are conducting research to think about their activities in different ways. However, the most enabling form of research, we propose, is as co-researchers where the design and implementation of research is done with research participants.

Three modes of researcher as ideal types are represented in Figure 3.4, situated in a transition from research as an objective inquiry framed by research owners to an inquiry which evolves from the conversations between people involved in research practice as a multidisciplinary research activity. In the context of CCA research ultimately the goal is to move towards co-research in discussion with others who finds themselves in a situation in which there is desire for improvement (Steyaert and Jiggins 2007; Ison et al 2007) and to empower research subjects to investigate issues that concern them (Burns 2007; Ezzy 2002, p. 76).

Evidence suggests that to enable learning from the experience of research practice it makes sense to engage those who are going to make use of the knowledge acquired and to understand ways in which research can provide them with an ability to respond to a situation (Ison and Russell 2010). Moving towards co-research requires fundamental changes in which research relationships have been conceived and open questions about who actually does the learning in the practice of research (Ison and Russell 2010).
Figure 3.4 Three modes of research practitioner as observer, facilitator and co-researcher
Chapter 4 Climate change adaptation research: findings

4.1 Key document discourses and framings

In order to situate the interview data from inquiry 2 within the wider context of research and policy direction, we first provide an outline of the key discourses (core activities) and framings (boundary issues) evident in the selected key documents. The three documents chosen for analysis of discourse in the wider context were:

(i) IPCC Fourth Assessment Report (2007)
(iii) Victorian Government Climate Change Framework Green Paper (Victorian Government 2009b)

Two DPI policy documents were also analysed to examine how climate change research activity was being framed. These were:

(ii) DPI Agriculture and Fisheries Four Year Strategy 2009-2013 (Victorian Government 2009a)

The key documents reviewed originate in different contexts (Figure 4.1). For example the IPCC document is distinguished by way of its framing of climate change as inclusive of climate variability. IPCC presents itself as an international scientific body formed specifically to provide independent advice to policy makers. The L&WA national document also provides an independent source of advice to policy albeit through a focus on primary industries. The third key document is a technical paper for wider community consultation in developing the Victorian government’s policy framework for climate change. The nested hierarchy depicted in Figure 4.2 is a particular way of situating those documents in relation to each other on a geopolitical scale of influence ranging from the international to national and state context. These documents were all influential on the way CCA research developed within the DPI and were seen to provide the guiding force for CCA research framing and implementation in the DPI prior to commencing this research.
Other documents which were not analysed were also associated with the development of VCCAP research. VCCAP, described in more detail in section 4.1.3, was a larger program of research within Victoria across several areas of government. Indeed the Sustainability Action Statement (2002, 2006) was a key document that directed investment in VCCAP activities through the Department of Sustainability and Environment (DSE).  

4.1.1 Wider context

(i) International

At the international level the IPCC documents articulate a global responsibility for responding to changing climate. The intention is to provide knowledge about projected impacts and to support decision makers by enabling the development of well informed science-based choices in a political context of climate action.

Definitions of climate change

Climate change in IPCC usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is

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9 Another significant international document which potentially could have shaped CCA research in Australia is the 2008 Synthesis Report of the International Assessment of Agricultural Knowledge, Science and Technology for Development – the outcome of an international process in which Australia participated. Aspects of this report are drawn upon in Chapter 8 (see [http://www.agassessment.org/reports/IAASTD/EN/Agriculture%20at%20a%20Crossroads_Synthesis%20Report%20%28English%29.pdf](http://www.agassessment.org/reports/IAASTD/EN/Agriculture%20at%20a%20Crossroads_Synthesis%20Report%20%28English%29.pdf))
in addition to natural climate variability observed over comparable time periods.” (IPCC, Synthesis Report, p. 30)

The IPCC Fourth Assessment Review (2007) posed the threat that “[u]nmitigated climate change would, in the long term, be likely to exceed the capacity of natural, managed and human systems to adapt” (p. ??). It is on this basis that a range of scenarios were generated to assist understanding in how human action could avert the most dangerous impacts of human-induced climate changes. Scenarios are based on different trends in mitigating action that are possible within existing technological capabilities.

A wide range of mitigation options is currently available or projected to be available by 2030 in all sectors. The economic mitigation potential, at costs that range from net negative up to US$100/ tCO2-equivalent, is sufficient to offset the projected growth of global emissions or to reduce emissions to below current levels in 2030. (WGIII 11.3, SPM) p. 73

The particular significance of scenarios is to provide decision makers with a framing that is within human capacity to stabilise or lower the level of greenhouse gases in the atmosphere.

Many impacts can be reduced, delayed or avoided by mitigation. Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilisation levels. Delayed emissions reductions significantly constrain the opportunities to achieve lower stabilisation levels and increase the risk of more severe climate change impacts. (WGII SPM, WGIII SPM) p.73

The authors of the IPCC report are keen to emphasise the importance of sustainable development to avert the worst effects of climate change.

Making development more sustainable by changing development paths can make a major contribution to climate change mitigation and adaptation and to reducing vulnerability. (WGII 18.7, 20.3, SPM; WGIII 13.2, SPM) p.73

Decisions about macro-economic and other policies that seem unrelated to climate change can significantly affect emissions. (WGIII 12.2) p.73

The authors also recognise that adaptation is unavoidable as the effects of greenhouse gas emissions are already being witnessed and felt. They acknowledge that the understanding of adaptation and its real costs is difficult to ascertain because of the uncertainties of how climate change will pan out in different contexts.

Barriers, limits and costs of adaptation are not fully understood, partly because effective adaptation measures are highly dependent on specific geographical and climate risk factors as well as institutional, political and financial constraints. (WGII SPM) p. 73

Furthermore, the significance of effectively measuring the costs of climate action depends on the kinds of assumptions used to project pattern of growth, change and consumption. There are limitations in knowing exactly how individuals and collectives will respond.

Estimates of mitigation costs and potentials depend on assumptions about future socio-economic growth, technological change and consumption patterns. Uncertainty arises in particular from assumptions regarding the drivers of technology diffusion and the potential of long-term technology performance and cost improvements. Also little
is known about the effects of changes in behaviour and lifestyles. [WGIII 3.3, 3.4, 11.3]

The effects of non-climate policies on emissions are poorly quantified. [WGIII 12.2] p.73

IPCC offer a definition of climate change (as outlined earlier) as changes related to both natural climate variability and those changes induced by human activity. They also provide a clear indication of what they see as the main drivers of climate change.

"Global atmospheric concentrations of CO₂, CH₄ and N₂O have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years …. The atmospheric concentrations of CO₂ and CH₄ in 2005 exceed by far the natural range over the last 650,000 years. Global increases in CO₂ concentrations are due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution. It is very likely that the observed increase in CH₄ concentration is predominantly due to agriculture and fossil fuel use. The increase in N₂O concentration is primarily due to agriculture. [WGI 2.3, 7.3, SPM]" (p. 37)

Furthermore the IPCC report is unambiguous on the nature of the causes as a direct result of industrialisation including activities of land clearing and the consumption of fossil fuels, with warming accelerating beyond their worst case predictions from the third assessment report in 2004. The conclusion of the eminent scientific group is that adaptation is unavoidable and if continued will eventually mean human survival (along with other existing forms of life) will be severely compromised.

"There is very high confidence that the global average net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] W/m² (Figure 2.4). [WGI 2.3, 6.5, 2.9, SPM]" (p. 37)

"Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. This is an advance since the TAR’s conclusion that “most of the observed warming over the last 50 years is likely to have been due to the increase in GHG concentrations” …. [WGI 9.4, SPM]" (p. 39)

The following examples of planned adaptation by the agricultural sector envisaged by the IPCC cover possible adaptation opportunities or strategies, the underlying policy framework, and the key constraints and opportunities for agriculture underpinned by an adjustment to existing activities and institutional reforms. (p. 57)

"Adaptation opportunity/ strategy: “Adjustment of planting dates and crop variety; crop relocation; improved land management, e.g. erosion control and soil protection through tree planting

"Underlying policy framework: “R&D policies; institutional reform; land tenure and land reform; training; capacity building; crop insurance; financial incentives, e.g. subsidies and tax credits

"Key constraints and opportunities for agriculture: “Technological and financial constraints; access to new varieties; markets; longer growing season in higher latitudes; revenues from ‘new’ products” (p. 57)
(ii) National

At the national level the emphasis is on developing innovative policy approaches to managing natural resources. In this national ‘framing’ document the awareness is directed towards environmental constraint and how research can support new approaches to sustain agricultural production within natural resource limits under changed climate conditions.

The National Climate Change Research Strategy for Primary Industries was developed with industry bodies as a means to engage with issues of climate change impact and adaptation. Its focus was on strengthening the partnership between research and industry as a means of encouraging cross-sectoral investment that maximised research design by ensuring communication between sectors and avoiding research duplication.

The particular policy focus for industry and government investment in preparing agriculture for adaptation emphasises the importance of risk management approaches to acting within a wider set of environmental constraints. The following quotes from the body of the text illustrate the dominant concepts and language, and thus framing, that has developed. The focus is on constraints, and innovation in resource management, including the accommodation of climate variability, couched in the language of change.

“Understanding climate change, the implications of climate change on production systems and regions, and the implications of policy, program, market and behavioural responses, is essential for primary producers and authorities responsible for natural resources. The development of management practices and technologies appropriate for changes in climate also has advantages for managing risk from climate variability, including drought.” (p. 16)

“Primary producers need to understand the implications of climate change on production systems (for example, quality and quantity of production) and regions, and determine how to respond. To do this, primary producers will need tools, technologies and alternative management systems and information about the appropriateness of practices and technologies under climate change scenarios.” (p. 24)

“The risks and opportunities from climate change will vary from industry to industry and alter their research priorities. Climate change will influence primary production systems in a number of ways, including changes to carbon dioxide concentrations, temperature, moisture and seasonal conditions. Research will be required to understand these impacts and account for them, which should be built into existing research programs, where possible, to underpin the future productivity and profitability of primary industries.” (p. 25)

The importance of additional areas for investment to drive innovative approaches to resources management and policy development are highlighted. This includes closer engagement with the users of climate information to promote involvement in the processes of decision-making.

- Develop and apply consistent meta-data to assist research investors and end users identify and report on research relevant to climate change and emissions management.
- Facilitate workshops and forums where climate change issues can be discussed within different primary industry sectors and regional communities.
- Invest in advocates and champions to raise awareness about climate change issues and facilitate primary producer involvement in decision-making processes.(p. 27)
Arguments are made for the need to better understand and promote improved practices through encouraging greater collaboration as part of a program of social research that enables practice change. The importance of dialogue is recognised in ensuring that the activities and decisions of researchers, policy makers and primary producers are well aligned so as to better understand the relationships between adaptation and mitigation measures.

“In managing for climate change, it is important that primary producers take into account the interrelationships between practices to manage the impacts of climate change, and those designed to manage greenhouse gas emissions. Adaptation to climate change and the mitigation of greenhouse gases are distinct, yet inter-dependent areas for action and investment.” (p. 32)

(iii) State

At this level the primary concern is in securing the economic and resource future of the state in relation to the challenges of a changing social and natural environment where greater risk and uncertainty exists. The dynamic environment of decision making at this level reflects the contingent nature of choices that have to be made in relation to the political decisions of others, including the effects of national policy innovations at the state level.

As part of the upcoming Climate Change White Paper, the Victorian Government wants to set strong, clear goals in responding to climate change. These goals and priorities should reflect the State’s contribution to national efforts to reduce emissions, as well as Victoria’s ambitions for managing and adapting to the impacts of climate change. The Government also wants to ensure that Victoria is positioned to take advantage of the new opportunities emerging from the introduction of a carbon price. (p. 3)

The emphasis of these documents is on the design and effects of carbon trading as a significant influence on responding to climate change. However since this time the Federal Government’s commitment to reducing carbon pollution through policy has been postponed.

“The introduction of the CPRS means that there is no longer any value in state and territory governments setting their own binding targets for reducing statewide emissions. Because circumstances vary across Australia, meeting national targets will be most efficiently achieved by allowing some states to make greater cuts than others. This is a major advantage of implementing a flexible policy tool like an emissions trading scheme.” (p. 7)

A ‘framing’ of direction as a nested hierarchy provides a basis for exploring how the political driver of global responsibility is translated into a strategic response to the social and biophysical challenges of climate change. In the Green Paper, for example, the emphasis in adaptation is in responding to extremities and managing changes in resource availability and competition with recognition of the need to change public service delivery frameworks. However the direction of that anticipated change is left open and thus is contingent upon the response in other areas of government including market-based developments of mitigation and adaptation measures at a national or global level.10

4.1.2 DPI strategy documents

The Victorian Future Farming Strategy was developed as a document to inform a whole-of-government approach to agriculture as productive, competitive and sustainable. It

10 As a result of the failure to introduce the CPRS at Federal level Victoria has in many ways been left to ‘go it alone’ through its most recent White Paper.
demonstrates the intent of the DPI in playing a leadership role in ensuring government supports this three pronged strategy for developing the agricultural sector. The Agriculture and Fisheries (2009-2013) Four Year Strategy provided the particular policy approach through which the DPI seeks to achieve these goals in the agriculture (including forestry) and fisheries sector. 11

These two documents were analysed to understand how the DPI activities were shaped by:

(i) the main goals or drivers of change;
(ii) the particular constraints or limitations in realising the goals, and
(iii) the skills and competencies required in overcoming constraints and increasing the potential for desired change.

These are now considered in turn.

(i) The main drivers

Drivers are those aspects of the situation that are recognised as in need of policy attention, those things which require a response out of the morass of other issues and elements influencing actions. They are the result of an analysis or of bringing certain things into focus to direct behaviours towards the pursuit of common goals or collectively shared ideals for agricultural policy.

(a) Future Farming Strategy

The Victorian Future Farming Strategy defined a number of key desirable actions to see the success of primary industries beyond the challenges of uncertain climates and markets. Action three of the strategy outlines a set of competencies and skills for understanding and managing climate change. It recognises that different contexts will require varied strategies across regions and agricultural activities and that to remain productive in a changing environment farmers will have to adopt new farming and business strategies.

A suite of activities is suggested as means for farmers to change their practices in a way that makes farming more tolerant to local climatic changes and other kinds of turbulence, such as market competition and changing social values. An outline is made of the types of problems farmers need to pay attention to in the broader multiplicity of drivers of change. Climate change adaptation is framed through attention to a range of new choices on diversifying varieties, shifting seasonal plantings, redesigning pest management, managing heat stress in animals and managing pasture productivity. It is significant that all of these strategies are essentially limited to on-farm actions. They do not expand to include farmer-to-farmer concerns, local and regional livelihood strategies, or aspects of socio-ecological resilience.

The key message from the Premier outlines the approach, as does the document’s subtitle, to maintain productivity at the forefront of DPI activities in relation to new development paradigms of ‘competitiveness’ due to global market integration and ‘sustainability’ due to resource and environmental constraints. This message is closely tied to technological innovation as the primary source of improvement directed at productivity and competitiveness. The integration of a sustainability discourse is secondary to these imperatives for Victorian agriculture.

“The aim of the strategy is to encourage innovation, increase productivity and make the farming sector even more competitive through the use of new technology and farming practices.” (p. 1)

11 This was the first of a ‘rolling’ four year strategy with the next version (2010-2014) appearing as this research was being completed.
A new era of farming

Nevertheless a new era of farming is seen as driven by a number of pressures, from social and natural environments, on the viability of agriculture. Such an environment is framed by unprecedented change driven by international competitiveness, development pressures, and changing values. Furthermore there are growing levels of uncertainty with rapidly growing market demand, financial uncertainty, and prolonged drought. Such drivers are thought to be increasing farming complexity in which a corporate approach to agriculture is represented as the pathway for increasing production efficiencies and emission reductions.

“Successful, competitive farm businesses of the future will also be larger in scale and scope. They will use more off-farm capital, specialised technical and financial advice, and non-family labour. They will plan strategically, and trade more actively in land, water, capital and their products to respond flexibly to fluctuating prices and climatic conditions.

They will significantly improve their stewardship of land, native vegetation, water and animals.” (p. 6)

“The growing complexity of farming will also drive a more corporate approach, involving further separation of ownership, management and labour across the sector. In addition, successful farm businesses will use a wide range of risk management tools to manage cycles of weather and prices.” (p. 6)

Seven actions are proposed to help drive the sector through the challenges of change. They comprise key areas of investment in DPI activities including technology, skills education, adaptation planning, managing resources, future family (health and wellbeing) security, product and market innovation and transport infrastructure. A total investment of over $200 million dollars gives technology and transport infrastructure 75% of the total investment. Of the seven action areas that the Victorian Government has committed to deliver through DPI the focus of this analysis is in the function of understanding and managing climate change as part of the investment in adaptation planning.

“New support of $11.5 million to help farm businesses to plan for climate change and to provide farmers in key industries with new technologies and strategies to adapt their farming systems to future climate conditions.” (p. 3)

(b) The Four Year Strategy

The Four Year Strategy dovetails the key strategic document driving a whole of government approach to future farming in Victoria. It recognises two other key documents as significant co-strategies in achieving a productive, competitive and sustainable agricultural (including forestry) and fisheries sector. They are the Timber Industry Strategy and the Biosecurity Strategy. In 2009, at the time of the strategy initiation, the Victorian government’s white papers on Land and Biodiversity and Climate Change were also deemed relevant to DPI’s strategic investment planning.

Within the Agriculture and Fisheries Four Year Strategy 2009-2013 the environment of change is represented by the immediate uncertainty and the future orientation of the strategy. The timing of the strategy followed the global financial crisis reflecting concern about financial uncertainty. Against this there is an expectation of growing market demand through continued development of markets in China and India, especially for core Victorian commodities such as milk and meat due to the growing affluence of these countries. However these countries will also be competitive through access to cheap labour, larger seasonal production range, and ‘natural’ advantages including economies of scale.
“While strong growth in many markets is expected, challenges including global financial uncertainty, significant new competition from developing countries, climate change and emissions trading, increased competition for natural resources, particularly water, rising concerns globally relating to food security, the changing social landscape, especially in rural areas, will also impact.” (p. 1)

According to the Deputy Secretary's opening message the strategy will play a role in outlining the government contribution to "strong growth", “thriving innovation and ‘quality’ jobs” and “protecting the environment for future generations”. The major driver from the Four Year Strategy is the importance of the sector to the wealth and wellbeing of Victoria and vitality of rural and regional Victorian economies.

Several areas are highlighted as important aspects of primary production which are exposed to climate risks. These include wealth, employment, national significance in food and fibre and dairy industries, the nation’s largest area of plantation forestry, paper, printing, writing and packaging manufacturer. Security of the economic and resource base of Victoria is the dominant framing for CCA research at the state level. In other words working within constraints to maintain and improve the existing use of resources against competing market demands and climate risk.

(ii) Constraints and limitations

Constraints can often lead to innovation and represent an important driver for changes as well as key policy drivers. They are the perceived limitations within the social and natural environment that prevent goals and objectives from being realised. In this case they are an important reference for the design and development of particular competencies in overcoming them. The two strategy documents are now considered in turn.

(a) Future Farming Strategy

The simplest way of describing the kinds of constraints outlined by the strategy are the set of risks to a productive, competitive and sustainable agricultural sector. Included in the description are future risks in meeting the challenge of uncertain market prices and demands, and the coupling of the extended drought and competitive global markets on investment returns. Direct risks to business are also noted as pressure from drought, water scarcity, labour shortages, increasing competition and long term impacts of climate change. Additional business concerns include changing risk and risk perceptions of exotic pests and disease as well as community and consumer concerns about biosecurity risks.

Advances in global development are also seen as potential constraints through intensifying competition as agriculture expands into South America and Asia and subsequent demands of agricultural inputs such as fuel, fertiliser and finance increases. Trade negotiations are currently represented as constrained by the slowed rate of negotiations in achieving market liberalisation of the developed world economies. Land and water resource competition is viewed as a constraint in further developing agriculture in Victoria, not just in direct terms of market competition but also in higher community demands for environmental sustainability. Scientific uncertainty is another type of constraints in which climate history is no longer seen as a reliable guide to future climates.

(b) Four year strategy

The Four Year Strategy mirrors the constraints of the Future Farming Strategy with the addition of land use pressure in a state context of rural and regional development and in the possible constraints of an ETS on agricultural production. Greater detail is also given in relation to climate change constraints on agriculture in terms of food quality, lower yields,
event damage, reduced water, heat stress, rainfall variability, animal welfare, salinity risk, forestry yields, fishery yields and ocean acidification.

(iii) Skills and competencies

Skills and competencies are those things that are encouraged in policy and program stakeholders. For the DPI Future Farming Strategy that means farming families, rural communities and individual farmers. Competencies are the desired behaviours that government encourages to deal with a particular issue or meet the challenges of particular drivers.

Table 4.1 Action areas for DPI Future Farming Strategy and Four Year Strategy

<table>
<thead>
<tr>
<th>Future Farming Strategy</th>
<th>Four Year Strategy</th>
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<tbody>
<tr>
<td>Boosting productivity through new technology and changes in farming practices</td>
<td>Developing a strategic policy framework</td>
</tr>
<tr>
<td>Building skills and attracting young people to farming</td>
<td>Driving innovation in science, technology and practice</td>
</tr>
<tr>
<td>Understanding and managing climate change</td>
<td>Developing and operating efficient markets and regulatory frameworks</td>
</tr>
<tr>
<td>Strengthening land and water management (including pest and weed management)</td>
<td>Negotiating and facilitating major investments</td>
</tr>
<tr>
<td>Helping farm families to secure their futures (particularly health and wellbeing)</td>
<td>Managing emergencies promptly and effectively</td>
</tr>
<tr>
<td>Developing new products and securing new markets</td>
<td>Achieving excellence in corporate and business management.</td>
</tr>
<tr>
<td>Transporting products to market (specifically grain rail freight).</td>
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</table>

(a) Future Farming Strategy

Outside of the explicit actions and investments committed by government to support the implementation of the Future Farming Strategy there are a number of areas in which competencies are suggested. These include building capabilities for resilient adaptability, building on a ‘proud history’ of adaptation to change and realising prosperity through plenty and adversity. Other areas of desired skills in agriculture are in recognising opportunities including in plantation forestry and aquaculture; technological and market innovation such as those possible in emerging water and carbon markets; increased productivity, e.g., through more productive varieties; and developing environmental credentials in growing demands for ‘clean and green’ food.

Other desired capabilities are in direct responses to drivers such as improving practices in risk management not only of financial and business risks but environmental and climate impact management. There is a desire for stronger awareness of development pressures amongst the sector communities to better prepare themselves for new patterns of land use, threats from exotic weeds and pests, and changing community and consumer expectations. At the same time the ability to exploit associated opportunities in ‘boosting productivity’ through managed risk, becoming more innovative and sustainable and gaining access to highly competitive domestic and overseas markets. Against growth in productivity, additional competencies are sought in responding to social and environmental value changes demanding more sustainable use of resources and improved animal welfare and product quality and safety.

(b) Four Year Strategy
The kinds of competencies sought through the implementation of the Four Year Strategy focused on efficiencies, innovation, environmental protection and social responsibility towards understanding and managing risk. Competitiveness drivers stimulated the need for the efficient use of natural recourse including water and resource use efficiencies as well as efficiency frameworks, growth capacity, efficiency infrastructure and management. In terms of innovation the focus was directed to providing quality jobs and thriving industries through skills and capability in innovation.

Social and environmental values were driving competencies in environmental protection for future generations including water security and supporting health and lifestyle quality including aged care innovation. Other social responsibilities in understanding risk were directed at competencies in emergency management, climate change management and various disciplines in sustainable products and harvest including organic methods and fair trade.

It seems the vision for the strategy in its broadest sense is progress within a risk managed environment in which the emphasis is on maintaining a course of development of resource use efficiencies and technological innovation.

“Enable transformation in Victoria’s primary and energy industries to sustainably increase wealth and wellbeing while protecting and enhancing safety, community, animal welfare and environment”

The role for government is framed within a particular set of competencies to support the development of efficiencies and innovations in agricultural businesses. Some of these are tied to familiar public service approaches including corporate and business management and developing a strategic policy framework. Such managerial and strategic options are public service values deemed worthy of maintaining in the face of uncertainty and unprecedented change. However additional disciplines are being pursued including driving innovation, market efficiencies, facilitating investments and managing emergencies to support agricultural futures.

It is worth noting that sustainability is configured as sustaining the increase of wealth and sustainable businesses, which seems to reflect a need for business resilience against market and environmental uncertainties. The continued growth of wealth for the state drives the major policy discourses and the protection of assets supporting wealth creation is a risk to be managed. The FFS is a whole of government statement which positions DPI as the lead agency driving competencies in productivity, competitiveness and sustainability and gradually adding more disciplines to the practice of farming into the future to ensure its wealth creating attributes are retained.

“Some of the broad issues emerging from a recent 20 year foresighting and strategic planning workshop DPI conducted with the sector have been incorporated in the drivers of change and future challenges and opportunities.”

<table>
<thead>
<tr>
<th>Table 4.2 Strategic change in Four Year Strategy from 2009 to 2010</th>
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<tbody>
<tr>
<td><strong>Six strategies (2009)</strong></td>
</tr>
<tr>
<td>Developing a strategic policy framework</td>
</tr>
<tr>
<td>Driving innovation in science, technology and practice</td>
</tr>
<tr>
<td>Developing and operating efficient markets and regulatory frameworks</td>
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</table>
In an annual review of the Four Year Strategy, the Department Secretary Richard Bolt presents the document as a response to the dynamic environment of government. The Four Year Strategy now works within four other strategies within the DPI translating their objectives into operational direction and priority areas for DPI investment.

“In response to this dynamic environment the Government has recently launched a number of strategies to assist in reform and transformation of the sector to deliver competitive products into the future. These strategies explicitly recognise the need for government to better target and tailor its involvement in the sector into the future.”

(DPI 2010, p. 1)

This indicates that the conditions through which this research was initiated are not the same as the conditions in which its outcomes are now being framed. The white papers on Land and Biodiversity and Climate Change are no longer primarily framing investment but being replaced by the Better Services to Farmers policy. Secretary Bolt acknowledges that the strategy is a ‘rolling’ strategy and updated each year to “reflect changes to government policy and shifting trends in the external environment” (p. 1). Ultimately the strategic direction is to be guided by a longer term strategy and exploratory efforts of the DPI in specific focus areas.

The focus on wealth and wellbeing is now given more diffuse attention between economic, social and environmental outcomes including: “competitive businesses and efficient markets”; “engaged, safe and responsible communities”; and “sustainably managed natural resources” (p. 7). Furthermore the six strategic actions from year one have been revised to replace the sixth strategy of achieving excellence in corporate and business management with “enabling departmental performance” and “develop partnerships and engage with industry, community and other stakeholders” (p. 7).

These two policy documents were used to reference the direction and management of VCCAP, which was the main climate change activity coordinated within the department’s program and project management cycle (see Chapter 2).

4.1.3 VCCAP

VCCAP is an interdepartmental program under the Victorian Government’s Environmental Sustainability Action Statement (www.greenhouse.vic.gov.au). DPI’s focus within the VCCAP is ensuring that Victorian agriculture, forestry and fisheries can adapt to a changing climate (Figure 4.2). There are two means believed to be necessary for achieving this: 1) increasing knowledge and capability (of government, agricultural and agri-businesses, rural communities and individuals) to make good, informed and holistic decisions; and 2) maximising the benefits and minimising the economic, social and environmental costs of climate change.

VCCAP aimed to deliver knowledge to ensure the regional economy continued to support diverse industries producing safe, healthy food and economic growth despite uncertainties, not only with climate but other dimensions of financial security and global competition. In
strategic terms VCCAP was directed toward equipping decision making with appropriate knowledge, guidance and tools for making informed and holistic decisions; increased understanding of impacts on primary industries’ business operating environments, including the ability to identify opportunities and adaptation strategies; and integration and collaboration with local, state, national and international (business, civic and research) communities.

Figure 4.2 VCCAP research structure (DPI 2007-2010)

The aims of the VCCAP research were directed at maximising benefits and minimising risks; couching CCA in a familiar language such that the research could be readily transferred to policy and other decision making contexts. It was framed in a way that did not make a significant break from the past by continuing trajectories of research into efficiencies and competitiveness while at the same time responding to changing social values around issues such as biosecurity, food safety and environmental management.

In conjunction with this backgrounding of the context in which research management and practice takes place, our interviews with key stakeholders provide a basis for exploring the realisation of policy in to practice. The following discussion of the interview findings is designed to illuminate a description of the ‘system of inquiry’ and key areas in which practice may better support the integration of research across diverse issue areas outlined by the policy documents and knowledge needs, and different conceptual models of research.

4.2 Interviewees’ descriptive accounts of CCA research

The findings from the interviews are presented as an analysis of participants’ responses to the two lines of interview questions (Table 4.1). These responses capture the view of participants situated by their particular management or stakeholding context, which is later reflected upon in relation to the policy documents and VCCAP research outputs. First an outline of participants’ roles and main stakeholding is given. This is followed by a description of the threats posed by climate change as perceived by respondents and how they consider research might be able to make a difference, what research actually looks like on the ground
and what barriers exist to making a difference. The content of these descriptive responses is used as the basis for describing CCA in the DPI as a ‘system of CC inquiry’.

4.2.1 Role and stakeholders

There were a variety of roles represented by the set of interview participants including principle scientist, policy manager, research manager, research director, project manager, planning policy, key project manager, program leader, program manager, research agronomist, and strategic manager. Some of these roles were described as connected to different fields of research and disciplines. The variety of fields in which participants worked ranged from animal, production, crop science, horticulture, farming systems, research extension, practice change, natural resource management, water science, policy making, economics, planning policy and development, land use planning, transport infrastructure, and so on.

The intention of this selection was to generate a range of different views of CCA research within the FFSR division as well as gaining a limited number of perspectives of CCA research, from outside the FFSRD and also outside the DPI. All interviews, however, had some stakes in FFSR activities. Some participant had a direct role in climate change research while others had a climate change role within a suite of other activities. Some worked within a single disciplinary area such as plant production while others worked across a range of disciplines such as natural resource management, crop science and animal production. Furthermore some recognised their activity with a single body of stakeholding while others had multi-stakeholding interest in their activities. Stakeholders included policy makers, various departments and ministries, state and federal government, industry and regional bodies, farmers and farming communities, as well as researchers and the wider Victorian community.

In this analysis ‘stakeholding’ is used to refer to the material interest in the situation that participants hold for others. Participants’ response to who they saw as their main stakeholders and the types of activity in which they were involved is represented here as a diagram including, e.g., the roles of strategy and conversation, policy influence and line management (Figure 4.3). Participants’ representation of a range of stakeholding from policy makers to industry, farmers and communities provides an illustration of ‘purposeful activity’ in relation to others for whom that activity is intended to serve and containing CCA research as a ‘system of inquiry’. Each activity is bounded by what people say they do and the intended outcomes of activity for each of their stakeholders.

A summary account of participants’ stakeholding is captured by each bubble in Figure 4.3 illustrating the diversity of perspectives engaged in this inquiry. Each of the bubbles represents the stakeholding for each participant thus there are twelve bubbles (the two stakeholders interviewed together are captured by one bubble). Within each bubble there is a label which refers to who or what the participant suggests as their main stakeholding activity. There is also a set of one or two broken line bubbles within those larger bubbles that describes the purpose of that stakeholding. A second set of closed bubbles describes how the participant has described their role in executing that purpose. For example one participant sees his stakeholding for the State minister and the wider social economy in which he acts to influence policy design to ensure the state is not disadvantaged. He does this by understanding policy impacts and by influencing the political agenda.

Figure 4.3 shows most relationships with stakeholding as represented by unidirectional influence between the purpose and how it is executed. However two sets of relationship show reciprocal influence with feedback between the purpose and how it is executed, e.g.,
where farmers and multi-investment stakeholders become engaged in questions of purpose. In these two cases research is shaped to some extent by those stakeholding groups. In all other cases research activity is represented as being ‘provided’ by the organisation. These distinctions are noted for the purpose of considering who guides research inquiry and who learns from the process. For example, in the case of multi-investment stakeholding where a project has multiple investors, there is a reciprocal relationship between managing stakeholders’ expectations and generating a shared vision.
Figure 4.3 Diagrammatic representation of participants’ main role and stakeholding in research
4.2.2 Threats posed by climate change

Table 4.3 Perceived threats posed by climate change

<table>
<thead>
<tr>
<th>Threat</th>
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<tr>
<td>Retaining productivity and food security</td>
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<tr>
<td>Mental health and community wellbeing</td>
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<tr>
<td>Climate uncertainty and less predictability</td>
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<tr>
<td>Competitiveness and business sustainability</td>
</tr>
<tr>
<td>Reactionary rather than anticipatory politics</td>
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The main threats perceived are outlined in Table 4.3. Although most participants saw climate change as a threat, others stressed the importance of being able to talk about opportunities arising from climate change. It was also important to some, despite the significance of the threat, to try and tackle the situation optimistically. For example being able to talk through ‘normal’ climate variability so as to not scare potential audiences was a sense of responsibility shared by participants in management and stakeholding roles.

“I’m really not thinking of it as a threat; I like to think of it as an opportunity. I think the threat is if we do nothing, sit on our hands and just say it doesn’t exist…” (M006)

“And I reckon that [reduced water availability] has had an impact on the way that our crops have grown, the way we select the crops already. So I think we’re already adapting.” (M003)

\[(i)\textbf{ Retaining productivity and food security}\]

However the main threat of climate risk and the kinds of knowledge needed to prepare for action included storylines such as the migrating climate zones associated with increasing temperatures, the reduced supply of water and the subsequent concerns about global food security. There were also concerns about the relative importance of climate change issues against the wider mix of policy problems and competition for research funding. In biophysical terms the threat to food security with changes in temperature and water supply aroused concerns for some that stakeholders will not act quickly enough to make the most of opportunities to change how they produce food.

“The issue is that sort of exponential increase and change and where that ends up. I think that there’s a real risk if it reduces our ability to produce food, and especially worldwide…” (M003)

“I think there’s a whole lot of issues around managing change, our ability to produce both from a, I guess right across the industry in terms of yield, continuation of supply and also quality of agricultural production…” (M004)

“I think the threat is our failure to act, our failure to balance off the needs of water, the needs of population in terms of water and agriculture, in terms of water and to adapt, then that’s when it’s a threat.” (M006)

“So in the broader context I think one of the biggest impacts for Victoria is going to be about water. So the whole water issue is going to just get ramped right up because the modelling is saying that; as rainfall decreases, runoff decreases at a greater rate than decrease if you like.” (M010)

“I think it’s already started because of the tactics not because of the poor planning, it’s because we’ve needed to because basically we’ve run out of water in certain situations, so we’ve had no choice. So I think that’s the big challenge we have for a dryer and warmer southern Australia.” (S009)
(ii) Mental health and community wellbeing

At the same time there was concern about sustaining a viable population of farmers with the capacity to adapt to anticipated changes in climate in a timely and effective manner. Others saw more social problems emerging, e.g., in relation to competing uses of water, to health consequences of climate change (including mental health), and the possibility of increased social conflict over food scarcity.

“So we're going to see a coastal movement of all agriculture which does have a lot of impact for the communities in the north of the state.” (M001)

“The key is temperature issues, extreme heat and the threat that poses to health and infrastructure...” (S002)

“...I think with the increasing population, I really feel we’re going to be facing some major challenges. And I think there are going to be wars fought over water and food.” (M003)

“There’s a lot of unknowns, uncertainties, and ultimately if you don’t have a certain amount of certainty and predictability then it’s a very difficult job for people to stay mentally healthy, to have the mental health to stay in a business...” (M011)

(iii) Climate uncertainty and reduced predictability

Thus there were perceived threats in terms of biophysical changes as well as social and cultural responses to such threats. Concerns about denial and unwillingness to change or anticipate changes in climate were represented as challenges to successful adaptation while the psychology of climate uncertainty and the inability to predict and be prepared for extreme events was another dimension of social responsibility felt by interviewees.

“...there's also the extreme weather events that we, to the extent that we believe that climate change may exacerbate extreme weather events both the frequency and the extremity...” (S002)

“A sense of unpredictability: that's the thing that I think's most threatening. As gradual change which we might experience I reckon that we'll probably deal with that better than these short, sharp things.” (S008)

“...the fact that you have to commit to something and you don’t know what's going to happen in the future and understanding how those plants are going to respond in a particular environment.” (M011)

“I think immediately there's real communities don't know how to respond, they don't, a lot of them are still are in denial or don't believe.” (M004)

The concern that the issue presents just one of many other risks that farmers confront and may fall off the political agenda limiting the supply of funding for research was perceived as a threat by research managers. This was expressed as social and political externalities influencing the kind of research being supported. In addition, one stakeholder thought that less predictability in climate extremes and when they might occur would lead to exposing investments in agriculture to higher risk. However from another perspective a more considered and anticipatory response to threats that not only addresses climate uncertainty but the potential mental health and community wellbeing issues that may flow on from the loss of investment certainty was concerning.

(iv) International competitiveness and sustainable wealth

A set of issues stemmed from the uncertainty of emissions trading that centred around international competitiveness and sustainable wealth. Several participants spoke about
the ‘policy impacts of emissions trading’ against concerns that ‘agriculture was invisible to the state’. On the one hand there were socio-economic dimensions of world trade expressed as the ‘challenge of international competitiveness’ and the ‘agricultural supply chain’. However there was also concern about perceptions as well as economics in relation to ‘how other nations perceive us’ adding to the range of ways in which participants responded to the challenge of emissions trading as a social responsibility.

“...the second side is the policy impact because you’ve got the Federal Government intent on applying emissions trading to agriculture. ... If you take the average farmer that’s had one successful crop in ten in the Wimmera Mallee and then introduce a carbon tax on top of that, they’re out of business.” (M001)

“Agriculture is very invisible to the state, because it’s, it was interesting, even in Ararat where people didn’t understand they were standing in the middle of a big factory that just didn’t have smoke coming out of it: it’s called agriculture.” (M006)

“The challenge for us is our international competitiveness. As we export a lot of our stuff, we’ve got things that are going to make it more expensive.” (S009)

“The other big challenge I think is to do with emissions and for our agricultural supply chain is that broadly speaking, Victoria has 3% of Australia’s Ag land, it produces 22% of Australia’s food.” (S009)

“It's our role at the international arena as well. And that's part of something that we have a role in there and there are threats to how other nations will perceive us as well.” (S005)

(v) Reactionary rather than anticipatory politics

In addition to the ‘measured’ dimensions of debates on emissions trading there was attention given to the reactionary nature of risk politics as crisis issues emerged rather than being in a position to anticipate their emergence. Participants provided a varied interpretation of this issue as funding governed by political agendas to industry not being too concerned about environmental change and a muted sense of catastrophe suggested by linear representations of temperature increases. Participants’ various framings of these issues included the funding ‘pendulum swings the other way’, the view of a lack of planning where ‘industry tends to react’ and not being prepared for ‘the planned step change’ required for a wider scale of adaptation against the ‘sense of urgency’, with concern about the ‘extreme event driven things’ driving policy development.

“... potentially from a research perspective. I mean it has provided a lot of funding that sort of comes, we’ve swung the pendulum that way and we start to bring back in the middle, perhaps there is a gap in terms of R&D funding, that’s more internal type threat.” (M004)

“The threat in a way is the changes are subtle and we may not realise the full impacts of them until later, and so normally private industry tends to react, the trouble is I think in this...” (M006)

“We weren't really looking at what are the step changes that we need to be making. I'm not on top of all the kind of work that we're doing at present, but I'm not sure that we're in the right space for it, in terms of the sense of urgency and really looking at the step changes that we have to adapt to.” (M007)

“The main thing I think is the extreme event driven things are the key threats. Much more extreme events...” (S008)

In summary participants perceived the threat is being realised both in biophysical and sociocultural terms, i.e., not just in real economic impacts but psychological and political responses. Cumulatively the perceptions of threats can be seen as being systemic. It
seems that managers and stakeholding participants anticipate significant changes in the way food is produced and that to have flow on effects to the rest of the community, but that as key players in the research field they are hampered by a lack of anticipatory action in relation to climate change. For example, there were concerns from within research management and its stakeholding about the relative importance of climate change issues against the wider mix of policy problems and competition for research funding. In biophysical terms the threat to food security with changes in temperature and water supply concerned research managers, particularly that stakeholders in the policy and farming community would not act quickly enough to make the most of opportunities to change the way food is produced. However as will be later noted there is some anxiety that public research may fall behind the pace of change in the community, decreasing its relevance.

4.2.3 Research making a difference

Table 4.4 Ways of making a difference through research

| Averting food insecurity by protecting food supplies |
| Adjusting to the effects of new environments |
| Removing impediments to change |
| Linking present and future choices |
| New techniques for engaging communities |

(i) Safeguarding food supplies

The main findings are summarised in Table 4.4. Participants' responses to how and for whom research made a difference included protection of food supplies as a critical need for everybody and averting the conflicts over food security. Availability and access to natural resources and international research collaboration were two other areas in which general issues of global food supply and population security were expressed. Another area of attention was to the bigger picture of how research could contribute benefits to the global supply of food as well as toward the development and practice of sustainability.

"Back in the early 80's, a report by the UN called Our Common Future. It really highlighted how the future of the world's sustainability in the world was going to be so dependent on education, but also food and access to natural resources." (M007)

"...everybody from the grower, the consumer, the industry, right up the food chain, I think it's going to have a big impact on everybody, farmers' bottom line to feeding people to food security and general security." (M011)

"But what would be possible to achieve if we had a global strategy for agriculture and adaptation adjustments and mitigation related to agriculture? Had all the science for agriculture across the world and relay it to energy minimisation and working towards the same goal in a synchronised way rather than a somewhat quasi competitive way." (M007)

(ii) Adjusting to the effects of new environments

There was a perceived need to get rid of some of the uncertainty as a means of supporting agriculture through change. For some this involved a picture of innovation in better matching plant traits to changes in environments as a continuation of existing technology in climate and land use modelling and plant breeding, e.g., by modelling and identifying new traits to incorporate in crops that aren't adapted to the environment.

"...the VCCAP type project that is very targeted towards policy to develop up understanding and tools and methodologies to look at regional change etc. Right down to
the component of doing some modelling and identifying new trait’s for future plants, so we can start breeding them now for the climate change.” (M004)

“...we’ve got a very different environment and we’ve got crops that aren’t adapted, so it’s a matter of taking hundreds of years of knowledge of exactly how plants capture sunlight and turn it into carbon...” (M011)

(iii) Removing impediments to adaptation
A third area of attention was awareness of the effects of government on action including helping people respond by linking changes in practice to future sustainability or by assisting individual choice to change in a way that best suits need. There was also attention to removing impediments to making informed decisions by taking a step back from the farm level as well as being clear on the role of government in advising but not taking control of decision making.

“We focus on removing the impediments to adaptation so if they want to move from this system to that system and there’s a block that government has control over, we focus on identifying what that impediment might be and we remove it out of the system so they can actually make an informed decision how to move the adaptation.” (M001)

“Make sure it's used and helps people respond in their own way, what's the right response for them? It's different, in all different nooks and crannies of the state, getting it to that place where it has to happen.” (S009)

“But there are others that want to change the business structure on the farm from the family, from an individual family unit ...we might have to re-adjust how we finance this because we need more capital to do this. Or we might need to have farms spread across climate zones. Or we might need to do some different things to amortise risks, just in case the dairy might need part of the grain farm to go with the dairy interaction into...how do we do that? We might need to have to lease to someone else, or we might exit.” (S009)

(iv) Linking present and future choices
A fourth was the area of planning and thinking about futures by linking choices in the present to desirable futures. This was supported by a view that farm businesses and community were tightly connected though services and food supply. Another area in which views were expressed in relation to production and food security included through recognising opportunities to develop business models that were more responsive to changes in environment. However this was framed as generating options rather than capacities to recognise opportunity.

“I think when we actually get to producers and consultants, they do want to know what the future might look like, but they need to know from a tactical management strategy for the here and now so there’s that dilemma about how do you link change now as to what’s going to happen in the future.” (M004)

“Well, as far as protecting food supplies or making a difference for all the primary producers, because they’ll sustain – they’ll have a sustainable business into the future, we hope.” (M003)

“But it’s also for the community for other reasons, for social and economic reasons, I mentioned before, I think if we don’t adapt, and adapt really quickly, there’ll be real food shortages in the future; that’s, in a nutshell, the high level of it.” (M003)

Developing leadership opportunities in terms of food security and using visualisation as guidance for decision makers were other areas in which it was thought research could
make a difference. However, some of these opportunities were thought to be limited by a lack of wider public awareness of the value of agriculture to the Victorian economy. Areas that were lacking included understanding the context of decision making and providing adequate spaces for exploring the value of knowledge with its potential users.

“It’s important in how people understand that the future’s going to be different [from] the past and the present. But we’ve got to be careful how much we invest in it. The other part of it is about developing approaches and systems to reduce the contribution to emissions. Then, the third part is really about how we respond and adapt and change to the new paradigm and that’s from a biophysical account and social aspect.” (M007)

There was a sense that past understandings and connections constrained changes including the value of agriculture’s socio-economic contribution. Rather than looking to social, environmental and cultural values of food production in Australia the traditional dynamics of the family farms were pitched against their value to the economy. This was a reminder that there is a significant wealth that comes off the land in the mode of industrial production.

“Agriculture is very invisible to the state, because ... people didn’t understand they were standing in the middle of a big factory that just didn’t have smoke coming out of it, it’s called agriculture... people in the town don’t realise just how much money is contributed to the town by the industry that happens around them ... it’s the same in Victoria we are fairly oriented towards secondary and tertiary industry, but we forget that there’s still a fair bit of the state’s wealth comes off the land.” (M006)

(v) New techniques for engaging communities

Another theme was developing techniques for engaging communities across different areas of social and environmental risk and to produce localised and personalised responses based on understanding how the future will differ from the past. Some advocated realising change through improved scientific awareness and by investing in community capability.

“...a lot of visualisation techniques are being used, which is great. So its engaging people across multiple fences so they can actually feel connected to the issues in different ways.” (S005)

“When we invest in research projects, we expect a quarter of research projects to be about communication. Then I talk to the managers of those projects from a research point of view and they say, we want to spend probably 10% on communications.” (S009)

“We’ve had a run of crap years, but I know from looking at the past record that things are going to get better, and we’ll turn it around”. So that’s what they base it on, and not necessarily understanding about the science is saying something different and that’s what we’ve got to convince them about.” (S010)

Another discussion covered the areas of policy targeted at rural change where research was typically over-determined by industry and their co-investment. There were possible alternative investment models that were seen as enabling choices but also building the capacity to make the best ones. This industry-based investment model limited cross-fertilisation of experiences and ideas and led to potential opportunities for innovation being missed or government being ‘captured’ by particular interests.

“So I think too much of the focus and discussion at the moment has all been done at an industry level. And in terms of our department is so caught up with co-investment.” (S009)
“What it might mean is that people will choose futures that aren’t right for some of those industries, but that’s just the nature of transformation. I’m not sure that that is getting the nature of how to set up, it’s not being nourished.” (S009)

“So we have different - like a threat to one person is an opportunity to others. I’m not sure, there’s a risk government could be captured. That’s an understatement.” (S009)

There were also views about more meaningful collaboration, e.g., in which research questions might be driven from a policy and community perspective; through narrative research which might better understand and open up opportunities to think about alternative business models; and by engaging in systemic modelling that moves beyond single focus policy issues towards the wider context of farming practice. In contrast to this perspective there were views about denial which underpinned the importance of opening dialogue with farmers and between research and its implications

“I don’t know what that would actually turn in to... whether it’s: ‘what are some of the risks?’ Opportunities are within the policy and within communities to help drive some of the questions that researchers might focus on. So maybe the questions are not focused quite as carefully as they could be: some of the issues that might be demanded of in the near future changes the communities and governments that make.” (S008)

Finally the farm gate was seen as the site for understanding complex policy interactions and the place where rational action and decision making ought to be made. This was not industry in its peak body form but the practical dimensions of interacting policies where there is a convergence of issues as opposed to industry-based framing of research areas. Furthermore there was a view that farmers don’t care what they grow as long as they can stay in the business of farming. Together these perspectives represented research as having gone from fragmenting to joining up farming industries.

“They’re concerned that policy makers come at things from a single focus and the result is that you’ve got all these single focus policies and regulations....but no one actually sits down and works out, the only person who really knows how they work in totality at the farm level is the farmer themself.” (S002)

“Because they’re the only people that have had the experience of all these different policy activities intercepting at their property. So farmers do think systemically and they’d like us to take that approach too, they’d far prefer us to come with a joined-up government, whole of government type approach.” (S002)

In summary participants considered a range of areas in which research could make a difference. Some focused on the totality of human existence with access to food and natural resources impacting on everybody, and the hope of a global strategy such that some of the uncertainty could be eliminated. Others sought to help individual respond in their own way by removing government impediments that might act as barriers to adaptation. From another perspective identifying and modelling changes in environments were aimed at supporting the maintenance and development of agriculture in different regions. There was also a focus on linking present choices to different kinds of desired future.

4.2.4 Research on the ground

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Responses to what research looks like on the ground are summarised in Table 4.5. Participants' examples of what research actually looked like on the ground included things like reframing projects as adaptation as well as measuring things, such as emissions and impacts. However it was also described as maintaining an optimistic denial of change in order to engage with people whom it was hoped would take up the research. One also noted that it could produce evidence that was counter-intuitive, requiring a significant investment of trust to motivate change in behaviours. Accounts were also given of how research was providing the opportunity for decision making about futures. This was supplemented by the view that research provided a visually-aided understanding and also by supporting decisions with a systems view of interacting elements. Research was also seen as necessitating an interpretation of context.

(i) Reframing projects as adaptation

Participants recognised that the change in policy on climate change introduced a new frame of reference for research resulting in a lot of existing work being reframed as “CC adaptation”. This was made clearest by those distinguishing between mitigation and adaptation research. While there was a view of research as involved in measuring things and applying experimental treatments and modelling work, it was thought that almost anything could be reframed as adaptation. Mitigation work ‘looks at measuring things’ and then ‘modelling it up’ to the system in which it operates. Such advice was configured as changing the ‘practice of nitrogen fertilisation’ with the recognition of how gases operate in the farming environment. Furthermore this produced a framing of attempting to ‘close’ the agricultural systems so as to minimise effects on climate by ‘addressing specific points of leakage’.

“...research that directly looks at measuring things, measuring gaseous emissions from soil, measuring gas emissions from animals...putting in experimental treatments to look at how these can be reduced. And then modelling it up into the whole farm system...” (M001)

“Can we change our practices of putting nitrogen fertilisers onto pastures or crops so we don’t get Nitrous Oxide emissions to the same extent? So those things are very much about addressing the specific points of leakage of greenhouse gases into the atmosphere.” (S010)

“...Adaptation is actually quite different because adaptation tends to be a bit of a mixed bag of almost anything can be reframed as adaptation...” (M001)

At the same time other perspectives indicated that the fragmentary nature of research projects made it difficult to link up and map the synergies across the various activities, e.g., understanding the interactions between carbon dioxide, temperature and water in a plant environment. Against this perspective there was a positive view of research where mapping across different domains of practice had enabled a new understanding of priorities or had led to unanticipated benefits.

“...like all our work, not just climate change work, there’s probably synergies across industries and across divisions but we probably don’t use it as well as we should or could. ... The way we pulled it together was we actually mapped out the whole chain, this is not to do with climate change, but we said, “Well, what do we do, what work do we do on fruit?”” (M003)

“...the industries, I think the research going on in the different industry bases seem to be still a bit fragmented.” (M003)

“...we’re looking at CO₂ and how water interactions interface, but not temperature. So I guess, in some parts, it’s a bit fragmented ...” (M003)
(ii) Using evidence to change behaviour

Some described a need to break out of past patterns of thinking and to accept a more open approach to examining the types of solutions that might ameliorate the adverse effects of climate on current practice. This meant thinking along the lines of new types of financial model and reconsidering how environments were built. It was important to be able to enable innovations beyond the existing multiple splits of research investment. This also required new types of institutional thinking such as creating spaces for foresight and sharing diverse perspectives on issues that moved beyond thinking in subsets of the whole. There was also a desire to bring responsibility down to a more localised level and to built capacity where there was direct exposure to changes in climate.

“There’s a limited shared understanding of a coherent response framework. A limited understanding of the role of targeted research that would support that.” (S005)

“...it’s sort of like a de-coupling of like the mental models or the frameworks I have and that will therefore constrain the sorts of solutions that I can begin to think about. So research into new financial models, research into urban redevelopment so how we start to reconceived the built environment at broad scales, whole city scales, research to enable a host of innovations.” (S005)

“...they’re still working within the bounds of existing systems, we’re not putting across to them that hey you might have to drop this system and go to another one...whether is a sort of threshold, where there’s a resilient threshold above which they’ll no longer be able in theory adapt, or to great constraint that they stick to their current system.” (S002)

‘Changing people’s perceptions’ was expressed as the need to get people involved in the discussions about the weather we’re having now as a means to think about increasing returns and reducing risk. However anxiety about a resilience threshold loomed large within this discussion. In this sense there was a perceived need to increase the focus on the reduced water availability as a part of a cycle of perception change. However this optimistic view of changing behaviours was underlined by a more disturbing view of short term mal-adaptations towards increasingly unsustainable practices..

“....all the new technology and every single thing in the world can account for four factors and the other six are going to be due to behavioural change...” (M007)

“...in Mildura they’re used to doing a lot of preparatory watering, and they were able to water their crops very heavily before [the long period of hot and dry conditions]... if water arrives at certain times now instead of the times it used to arrive, how has that changed the options the farmer has to maximise their productivity.” (M006)

This was seen as one way of having a conversation with farmers about how they might better prepare themselves for uncertainty and make decisions in a dynamic context. The downside of these discussions was that stakeholders felt that they could not talk about ‘climate change’ but could talk about weather in a more familiar sense of what actions had been taken, e.g., to accommodate to changes in rainfall patterns.

“...you might talk about stuff related to climate change, but you’re not going to put it up in lights as climate change, otherwise two out of three won’t come.” (S009)

“There is a sort of cycle where people go from don’t believe in it, to I believe in climate change, but I don’t believe in anthropogenic forcing. You sell it to them on the basis of increased returns, reducing a risk due to drought, essentially you don’t stress the climate change aspect.” (S002)
(iii) Understanding implications of forecasts

Having differently timed decisions was seen as a more critical way of engaging stakeholders in the need to change. This was understood as changed farming options with different decision points prior to making a shift to a new system. Research was seen to provide the support for better decisions with farmers using more perennial pastures and moving into new areas for cropping. Things like preparatory watering were seen as increasing flexibility through an experientially raised awareness in which there could be heightened recognition of opportunities.

“...there will be different points of decision compared to what there used to be, and a different range of options to make. ...you might still be a land producer, but the base system is quite different, and when you make those key decisions will be changed.” (M006)

“...the areas that are less favourable for cropping because of water logging would now be favourable for cropping...” (M006)

Making projections and understanding the implications of forecasts in terms of the consequences of a changed climate was discussed. However there was also concern about how effective those taking action could be without awareness of the consequences of human actions also on the changes in the climate. There were concerns that institutions were not flexible enough in realising the connections of the biophysical, economic and social with environmental change.

“Part of it's about trying to project and understand the implications of the consequences on what we've got and what it might look like in the future...” (M007)

“...how successfully we integrate the climate and emissions related information and lessons and stories in our mainstream production agricultural development...” (S009)

“...the third part is really how do we respond and adapt and change to the new paradigm and that's from a biophysical, economic and social perspective.” (M007)

“...I'm not sure whether we've done some smart thinking about policy: what's our adaptability in our policy? Where's the flexibility in using our policy space to deal with climate change?” (S008)

Against the views of technical modelling for understanding the global impacts of climate change including vulnerabilities and the adaptive capacity of people and institutions to change, was a view that visualising futures could help people in understanding change. By engaging in a discussion that might lead to an agreed picture of futures and the place of agriculture in them this view represented an active process of configuring region-wide or industry impacts. The modelling itself was thought to be 'ground-truthed' by being checked against people's perceptions of what was actually happening.

“....coming to not consensus but coming to sort of an agreed picture that if that's the future world, this is what our industry might look like in that future world. ...some of the modelling work we’re doing is developing up what the impacts might look like but then still going out to communities to get a reality check on that...that on the ground is really about coming up with pictures of what the impacts are like at a regional scale or at an industry scale and communicating that...” (M001)

(iv) Contextualising and engaging stakeholders directly

The contextual interpretation of models, it was thought, might lead to fast-tracking adaptation if used in conjunction with extension efforts. This was seen as a participatory approach to including stakeholders in the implementation, if not the design, of research.
Interestingly it was regarded as ‘time-consuming’ against an initial framing of ‘fast-tracking’ research. The question of how long it takes to spread this kind of research practice around the state constructs it as impractical. Despite this the hands on contact with research questions was viewed positively from the perspective of working in the field. This discourse of research activity as contextualising and engaging participants directly in the experience of research was shared across differently situated perspectives, within and outside the FFSR group.

"...there’s a project that is fast tracking climate change adaptation, which is where you’ve got to research extension and farm group, or a community where it's happening at that context locally. You get brilliant results of that participatory action research where farmers - everyone’s going along on the journey and their learnings are all shared. That's proven, it gives great results, but it's incredibly time and investment-heavy if you're trying to do that in every regional community." (S009)

Furthermore this language of a shared journey, despite the critique of being time and investment heavy was thought to be a better means of developing integrated information with relevance at the farm level. At the same time there were other perspectives on mainstreaming climate knowledge along with regionalising institutional players in a decision making forum to better facilitate a sub-district engagement in the development of climate change knowledge.

"...I'm meaning getting down to sub-district levels, where you've got a really high mix of real people, not just the leaders, but the leaders of activity." (S009)

"...I think the forms that are most beneficial are those that enable people to see and touch and talk about what is going on and what may be put in place for them to do differently ..." (S012)

"It's about getting contextual and then looking at the flow on effects and then saying well hang on the better way to it is to check the pipe size, not go and tell people to put more water on." (M006)

"...they can feel the experience that are a result of climate change and therefore research into it is perceived in a much more favourable light. ...it's actually advancing this perception on the ground because people are now being directly exposed to the outcomes of climate change..." (S005)

"At one end of the scale you have got stakeholders who are hungry for in depth research reports and at the other end of the scale you have got people who are perhaps not wanting any information at all, but you have a large portion in the middle who want to see and touch and talk about the issues in sort of tangible terms." (S012)

Another area for engaging stakeholders was the use of research in narrative to counterpoint the dominance of scientific rationality, which on the one hand was seen as inadequately addressing the issues for stakeholders. Narrative analysis was thought to open spaces for engagement on a level that might better integrate sciences with other ways of knowing about the impacts of climate and what could be done to transform practices on a number of societal levels.

"I think there’d be more narrative research that will be appearing and finding ways that day to day, the lifestyles and the way people live and work and do things, how that's going to be connected more dealing with issues of climate change. I think the nature of research will be changing as well." (S105)

"So it's from what perspective is the research question framed, and which perspectives are the methodologies used as well. So right now the funding around all of that is very strong in the scientific paradigm. And there are many other perspectives as well that can also
make significant contributions to all of the dialogue around climate change. And I suppose for me that means that we have to shift, we have build from, to focus on specific disciplines to inter- and I think trans-disciplinary research is something that will emerge in a dramatic way." (S105)

“That that will become very practical, it will not just be academic concept any longer. And that type of thinking is going to be required, I think, to re-address a wicked problem, a complex problem, you know, the systemic effects that are occurring with global climate change.” (S105)

(v) Biophysical interactions within the environment

Nevertheless even though there was a view of transforming decision making institutions it was not necessary for those managing research to make a difference at the farm level. In focus were the biophysical interactions between changes in climate and the ‘anthropogenic’ causes of greenhouse gases. At this level changes in a rumen’s gut bug populations and changes in use of nitrogen fertiliser were conceived as reaping benefits not only for climate but for production efficiencies. This view of emissions also shaped a view of the systems as a vessel, addressing specific points of leakage and modifying production systems.

“So in Australia sixteen percent of greenhouse gas emissions come from agriculture so it’s addressing the practices that are the cause of that. So those things are very much about addressing the specific points of leakage of greenhouse gases into the atmosphere.” (S010)

“...here’s what impact it might have on your current production system, therefore here’s how we might go about modifying that production system to cope” (010)

“So it’s just understanding how crops grow in different environments, there’s climate and soils and the whole lot .... I think we’ve been doing it for hundreds of years...” (M011)

From another perspective adaptation to climate change meant adapting existing approaches to knowledge to new environmental conditions. This essentially meant no significant change to how research was conducted but it did mean adding some new elements into existing models. For example the modelling and selection of plant traits based on European genomes suited to Victorian environments was adjusted by adding anticipated changes in temperature and rainfall.

Alternatively another viewpoint from outside of FFSR and the DPI recognised a need to change the way knowledge was generated as a way to shift the locus of responsibility for adaptation in ways that empowered people with knowledge needs. Furthermore this was seen as a way of introducing a broader picture of what was otherwise seen as a narrow focus of research by enabling experiential knowledge to shape research design. But it also meant managing diverse information needs.

“...how do we localise the thinking about the particular problem today? So okay, this department is responsible for that. So we localise the responsibility, and there are certainly perspectives and so well it’s a shared responsibility.” (S005)

“...so in some way it's like a lot of our targeted research now, it's like it's addressing subsets of the complete, the whole that we're trying to deal with. ...how do we share it in ways that are going to be interpretable by different stakeholders and different people, what's the language that we used to talk about research.” (S005)

Interviewees described a range of views of what research looks like on the ground including changes in practice, modelling emissions in the climate, research that is
fragmented, some maladaptive behaviour, enabling different opportunities, visualisation and modelling, increased capacity for futures thinking, and locally contextualised knowledge. Furthermore participants felt the importance of engaging in new research conversations, finding synergies across industries and where that breaks down, overcoming subsets of the whole not really making any difference, breaking free of the past conditioning of behaviour and rationality, importance of keeping conversations open, and of grounding research practice to get more rapid understanding and uptake.

4.2.5 Barriers to making a difference

Table 4.6 Barriers to making a difference

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<th>Research distance from decision makers</th>
<th>Raising awareness in the community</th>
<th>Psychological barriers and denial</th>
<th>Project funding and management</th>
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The areas in which participants perceived barriers to making a difference on the ground are summarised in Table 4.6. They included the social distance from researchers to decision makers including finding pathways to research utilisation; the degree of awareness in the wider community; psychological barriers and denial of stakeholders including understanding motivations of those whom research was intended to benefit; and project funding and management including certain aspects of organisational structures.

(i) Research distance from everyday decisions

There was concern that researchers were too distant from the everyday reality of decision makers. An illustration of this was the view expressed that researchers do not think of themselves as part of the system in which they are seeking change.

There was a view that having to engage with lay people was needed to get better knowledge utilisation. Others also shared the view that research ought to be taking that further step by going out to regions to realising that extension does not necessarily meet its target. This was supported by the perspective that producing a report may not be the most effective means of communicating, as stakeholders (people in government and industry) are time constrained to read them. The view that direct face to face meeting and phone calls were not part of routine research evaluation was supported by other perspectives that small group interaction was a necessary part of knowledge sharing with stakeholders.

"Well actually the only way it receives information is by direct face to face meetings with them and making sure they know what you can offer" (M001)

"...we had a phone call from one of the policy makers who just wanted one little bit of information. And he knew that I was the only person who could give it to him immediately." (M001)

"...to have the maximum effect in terms of desirable practice change, of course the researcher needs to have a very good understanding of the target market for that particular piece of research ... and then at the outset of the research a very clear understanding of the sorts of output that will be required the context they will need to be in, to have the maximum chance of making some difference. To ignore, and I’m not suggesting that this is the case, but to ignore some of the dynamics in the client stakeholder base round this issue would be erroneous, in my view." (S012)

From one manager’s perspective there was a view that government really ought to support investment in CCA research while another felt that more was going on in the field
than government could keep up with. Alternatively one of stakeholders expressed a sense that people who had research needs such as policy makers and community ought to be the one’s guiding research questions. This did not necessarily mean the traditional research owners, as stakeholders indicated that it was the outliers or non mainstream farmers that were innovators in practice change.

“I think one of the barriers, threats is, that some of the innovators potentially may be considered as a bit alternative or kooky or whatever and that might be where some of the innovation is actually coming from. So we’re not, so they’re not part of our traditional networks and our traditional client base etc, because they’re a bit out there, but that might be where some of the innovation is coming from.” (M004)

“I think we have to use our imaginations to better communicate what we’re about. So, barriers are there to be broken, there are ways of breaking them. I don’t know that we’ve always used our imagination well enough to do that.” (M006)

“...you have got people who are sitting along a very broad spectrum from people who are advocates and championing for more information and more action and then you have got people at the other end of the spectrum who don’t think it is a problem in the first place and then have probably got standard deviation, I suppose, with many people in the middle just wanting more information and the opportunity to talk to people. Better understanding of all of the implications and opportunities. If at the start of any research project we don’t understand that, then you are probably minimising at the outset your chances of making a major impact...” (S012)

“you need high quality, reliable, justified or well qualified research information that is presented to next and end users in a way that it is accessible noting the continuum that we talked about earlier and that may mean that for each understanding that the client and stakeholder sit along that continuum recognising that the one size fits all end product is probably not the starting point. So you are talking about a variety of different routes to market type opportunities to get their research through to end users is what makes the difference.” (S012)

There was some attempt to characterise those perceived as at the forefront of innovation from a policy perspective. Some considered that working at the interface with farmers become a priority, especially if researchers worked more closely with innovators and used their successes as a reflection for others that follow. Perspectives varied on whether government ought to be leading investment rather than expecting an industry contribution against adaptation happening faster out in the field than what research could keep up with. Nevertheless there was convergence in the sense of getting guidance from local people and understanding policy needs. Yet this view backed up against the perceived need for maintaining awareness of agriculture’s importance to the stability of life in Australia and better understanding of risk and opportunities.

“...a lot of our industry do it fairly tough, I mean, it’s difficult to invest in short-term pragmatic things that will help them now, let alone things that have not happened. So that’s why I think there’s this role of government, I think government really should be investing in climate change research and not expecting co-investment.” (M003)

“I think that industry and farmers will adapt quicker than what researchers will, and we’re seeing that already so there’s a, it’s because of the barriers, I think it’s a threat that we’ve become less relevant because the innovative farmers are pushing the envelope and we’re still back a few steps...” (M004)

“But I think perhaps there needs to be a bit more guidance from the people who need, who will gain value from the research.” (S008)

“I suppose as we were discussing earlier on is having the needs of really getting to grips of what policy needs would be, or the community needs are. I don’t know what that would
actually turn into whether it’s: ‘what are some of the risks and opportunities [that] are within the policy and within communities’ to help drive some of the questions that researchers might focus on.” (S008)

There were concerns about the relative importance of agriculture that supported other views e.g., that the threat posed by climate change was a symptom of a lack of wider community awareness of the significance of agriculture to their daily existence and survival. For a policy stakeholder this meant a need for more discussion of the implications and opportunities that research presented in the area of climate change.

“I think one of the big things is, this was a couple of years ago, but there was a big scare with food security, you know they didn’t have the wheat supply for more than 30 days or something like that and people suddenly realised that things are pretty tenuous with climate change, with the fact that research in agriculture has declined because everyone is not seeing it’s important...” (M011)

“Better understanding of all of the implications and opportunities. If at the start of any research project we don’t understand that, then you are probably minimising at the outset your chances of making a major impact.” (S012)

From the perspective of practice change, the barriers were seen in being able to link-up at the farm level. There was a strong critique of policy arguing that policy is all too often uni-focused and the only real direct experience of complexity is at the farm gate.

“They’re concerned that policy makers come at things from a single focus and the result is that you’ve got all these single focus policies and regulations, but no one actually sits down and works out, the only person who really knows how they work in totality at the farm level is the farmer themself.” (S002)

(ii) Raising awareness in community

Raising awareness within the community was an emergent theme. Participants talked about belief systems and addressing the issue of where people don’t believe climate change is happening, the diversity of information with the tendency to confuse people and the contribution of media and interests in selling papers. Against these views of the plethora of debates and issues on climate change there was an interpersonal perspective on where it was possible to have a conversation with people in an informal kind of way that enables an explanation, in a non adversarial way, of the IPCC findings and the peer review process so as to produce a story that makes sense and, in the process, to actually listen to people.

There was some concern from a research manager about the scientific community being unable to communicate in a way that shared that information. This paralleled another manager’s perspective that researchers are accustomed to communicating through reports rather than conversations.

“I think there’s an issue potentially with our researchers in terms of not being able to put the words in a broader context. And I think that’s a real issue, and not being able to communicate at a different level, when we’re needing to be told the whole systems type approach.” (M004)

“And unfortunately a lot of scientists believe that they’ll just write a big fat report at the end of their research project and that should influence Policy.” (M001)

However an alternative view was that rather than being concerned with direct engagement and communication it would be better to adopt a more reflexive perspective that asked researchers to place themselves in relation to others within the ‘research
system’. This perspective recognised the importance of finding and accessing the right people to facilitate the uptake of knowledge. Finding the ‘right’ connections on the ground however involved accessing those who are not on the mainstream radar of existing DPI networks. This was translated as finding imaginative ways to communicate.

“...if we, in these complex multi-disciplinary areas, we don’t apply the system to ourselves as well as to the system that we’re working on, we’ll miss the boat.” (M001)

“...we’ve also got to think more carefully about the pathway to utilisation because if we’re not engaging with the key people that can make a difference or get a message out to those that need to hear the message and communicating regularly with them, we’ll miss the boat...” (M001)

In relation to the making a difference, managers identified barriers in belief systems as an issue shared with others working in a more direct ways with stakeholders either as policy makers or actual farmers and others in agribusiness. However this was underpinned by a view that information overwhelms people rather than enables them. From this perspective the opportunities to engage people in conversations was critical to enabling a transformation.

“The barriers really are about belief systems, and the barriers are also about the diversity of information that I just talked about. I see that as a real barrier. Most of the other areas that I’ve worked in, in practice change, there’s kind of been one mantra, and it’s really challenged.” (S010)

“So we talk to a lot of groups, and generally they’re small groups where you can have conversations rather than stand up in front of fifty people and address them. They might be farmer discussion groups of a dozen people, or less sometimes, so you can get a meaningful dialogue with them and if they have got concerns then they’re more likely, because it’s an informal kind of system they’re more likely to stop you, or you’re more likely to perceive if they’ve put the shutters up and say, “Hang on a minute I can see that you’re not with me here, what’s the issue?”, and maybe address some of those things.” (S010)

“I think all of that, as a story makes sense to people, and because no one ever bothers to explain to them about what the IPCC is and how it works, and how vigorous its findings are, and then I talk about the fact that you might read about some other guy who’s got professor in front of his name or whatever, who publishes a paper that says that’s a load of rubbish and this is what I think, it gets the same amount of space in the Stock and Land, but where’s the peer review behind his paper that actually says that there’s broad agreement among the scientific community that he’s on the right track. So those sorts of things, I reckon, and that small group engagement really help us to clarify confusion for people.” (S010)

Practice change and the uptake of innovation was seen as about overcoming barriers in getting trials into custom and practice. In some sense the real work of adaptation was looking at how the innovation interacted at the farm level and reflecting that back to see how farming practices were actually transformed.

“...there’s a whole, there’s a bunch of science about, called practice changes which is about overcoming the barriers that science faces in getting innovation, technology and new practices out of the lab or the farming trial into custom and practice...” (S002)

“There’s also the answer sort of mirroring the whole picture, and perhaps fundamentally recognising so and if this is for the first group but the only way to truly continue from now on is to transform the farming practices...” (S002)
It was important from the perspective of those working in rural communities for finding places for conversations, e.g., with a small group in an informal setting. This was in part addressing the information overload and conflicting messages on the science and policy of climate. For realising practice change this meant being able to speak in a non adversarial way about the credibility of climate knowledge.

“So we talk to a lot of groups, and generally they’re small groups where you can have conversations rather than stand up in front of fifty people and address them.” (S010)

“...because it’s an informal kind of system they’re more likely to stop you, or you’re more likely to perceive if they’ve put the shutters up and say, “Hang on a minute I can see that you’re not with me here, what’s the issue?”, and maybe address some of those things.” (S010)

“Communication, I think is - so much information out there, trying to work out what’s garbage and what’s not, what’s sensible and what – even in the climate change debate people put out, even the IPCC put out some information that they had to go back through and it’s not quite correct and it loses credibility and then no one believes that and then everything else is just tossed out and not believed, and that information overload and sorting out what, and the priorities.” (M011)

(iii) Psychological barriers and denial

Psychological barriers were a common source of concern to participants both within and beyond the DPI including attitudes where people really don’t believe that climate change is happening. Some stakeholders in research saw this as the recognition that language was a barrier, which was followed by attempts to couch conversations in terms that were more acceptable to farmers. However there was also perception from a research management perspective that such barriers were in people’s head and that experience could change such attitudes.

“I mean some of the challenge of this is there are barriers, I mean clearly the fact that two thirds of our stakeholders don’t believe in climate change is a barrier. ... there is that, attitudinal disjunct I suppose actually differences between researchers, policy makers, and farm business, foresters is a barrier, language is a barrier.” (S002)

“I actually think a lot of barriers are in people’s heads, and it’s about looking at pathways around that and getting greater understanding of the wider picture of people. You have to accept that with some people you will not have winners, there is still a flat earth society.” (M006)

“...but at the moment a really big barrier about climate change research being taken up is the fact that people don’t necessarily believe they need to take it up, and that’s because they are just being bombarded with all sorts of opinions about climate change, and the credible ones get as much space as the incredible ones and that’s because it sells newspapers.” (S010)

However there was also a view that sought to try and characterise different types of personalities in farming that might lead to better structured conversations. This perspective was reinforced by another view working more closely at the interface with farmers who were making the transformation and holding this up for others to reflect upon.

“There’s willingness, time, there’s certainly attitudinal, some research has been done, there tends to be sort of a common classification which broadly speaking goes along the lines of conservative, innovative and transformational or something along those lines of conservative, modern and radical.” (S002)
The psychological disincentive to act on climate change meant that funding was an issue with some concern about the limited desire to finance research into climate change adaptation. This was expressed in a way that went beyond farming communities to the wider public and even in families where research managers were confronted with denial that the climate was changing beyond its normal variation.

“I think there’s still a lot of people, including in our stakeholder groups, that don’t really believe climate change is going to happen and I’ve met people, even at social functions... and they said, “It’s all bullshit” and, “I’m not going to design all these roads and bridges and things to take into account bloody climate change, it’s never going to happen, it’s a waste of time.”” (M003)

“I have arguments with relatives and farmers who are just saying we don’t believe in this climate change set up, and that’s fine. But don’t you think it’s a good idea to be able to deal with greater seasonable variability and to be able to keep your enterprise going in producing how ever many kilos of milk if it’s a good season or a bad season. Yeah that’s a good idea, right well lets just focus on that, and not worry about the philosophy.” (M006)

(iv) Project funding and management

It was thought important to have some initial investment money, in some respects to address multiple barriers of creating a space for innovation and to get the ball rolling into a new area of research. This was not just the view that researchers always want more money but that people on the ground can’t support research or change. There’s a bigger view here that concerns the longer term survival of agriculture against the unknowns that climate change might bring. Furthermore as expressed earlier, the inflows of climate change funding was a means to retain key research staff by ‘rebadging’ projects.

“A lot of it’s about overcoming barriers to change, and it can be, there’s multiple barriers, resource most changes need some initial money to invest in.” (S002)

“I think the other hurdle for us, when you mentioned funding and how funding drives everything, if you look far out there for some poor people struggling to make ends meet in the veggie patch right now, to think about what might happen and invest in what might happen in 30 years time when they don’t even have money for something that they need to find a spray or cure for right now, that could be a hurdle.” (M003)

“It’s like that old line I heard one of our senior managers use years ago when we said, “It’s hard to be brilliant when you’re in the red” and what he was referring to was how some parts of our department were pushing the growers to put in windbreaks and things for their cattle, and all this, and to increase biodiversity on their farms and that but if they had have done it, they would have gone bankrupt, they couldn’t afford it.” (M003)

At the same time the ‘good modelling capability’ and other activities was seen to have built the organisations reputation in the areas of climate change research with new funding networks and opportunities opening up as a result. However the possibility for collaborative alliances was not always realisable where staff were fully committed. So on the one hand there was more capability in the organisation as a result of CCA research but the value of that capability gets down to relevance, connection and communication beyond the internal workings of research management.

Against this perspective there was concern that staff still tended to think in divisions. This was directed at managerial staff. However it was clear also from observations that this was the case except where people had initiative to connect up and share resources.

“I think some, potentially some of our organisational structures are barriers we still even though we have projects that run across disciplines. It’s, we tend to think in divisions and it’s a bit harder to get joint projects that run across divisions, across industries.” (M004)
Sometimes ‘siloed thinking’ was related to knowledge and expertise but it was also affected by a kind of territorialism over knowledge domains, which restricted people’s will to collaborate. Furthermore it was a concern that even where there had been a ‘collaborative’ or ‘multidisciplinary’ emphasis as there had been with VCCAP, the projects largely were conducted independently and were then pulled together towards the end.

“I’ve had a similar experience through another large project that we were part of in terms of landmark, everyone gets their bit and they go into their disciplinary and they’re all comfortable and then some poor person has to try and pull it together towards the end.” (M004)

Someone has to perform this task of conceptual integration, which they do almost like fitting a jigsaw together. However, research managers are challenged with the task of blending divergent conceptual models and framings of research into an integrated whole. There were some disappointments expressed about this where the real substance of collaboration was not realised. This idea of the complexity of moving from strategic planning to actual implementation was realised as a problematic area where:

‘you think everyone’s on the same page then implement to find thinking differently [that we’re] not talking about the same thing’.

There was a view that funding was always a barrier but there has been some significant infrastructure and strategic investments. From another perspective the model of project funding and cycles was concerning where there was increasing pressure to produce more outcomes with less which resulted in a lack of depth in framing and developing research ideas. This was measured against not getting a lot of younger people coming into the areas and knowledge seen as dying out and being replaced with a lot more streamlined ‘McDonalds’ type of research.

“I mean a lot of people throw up funding as a barrier, but I think with our new structure we can actually facilitate that a lot more, I mean there’s always things in other, there’s only so much in the pie, but we’re much more in control of that.” (M004)

“...there's no doubt that funding is an issue: so focus the funding, focus the training, focus all of those things towards that kind of area and you'll get research in that area. That's obviously a barrier.” (S008)

“Barriers are project funding and cycles and it's just a roller coaster with funding continuity. I think we’ve got a really great team but I think things are getting really thin on the ground as far as critical mass and who is coming up. There’s not many people coming up from – we are not getting a lot of younger people coming up into the research area, there’s not a lot of jobs security, it's probably not as well paid as some things.” (M011)

In summary there were several areas in which participants noted barriers to making a difference including the lack of social interaction between researchers and those who were the intended beneficiaries of research. Participants also noted a lack of community awareness as a concern impacting the degree of engagement with climate change. Some indicated that this was a problem with science communication and others a result of contradictory information causing confusion. At the same time there was resistance due to denial in which participants felt that they had to alter the language they used to engage key stakeholders who were reluctant to accept the reality of climate change. Some also noted the existence of organisational structures such as funding and project management as barriers for research to make a difference.
4.3 Reflective analysis of CCA research

In the second line of interview questions participants were asked to reflect on practice. This was designed as a way of exploring those less orchestrated aspects of practice and to elicit a critical perspective on what they did in relation to the wider context of climate change impacts. It also provided a means of critical reflection on the internal organisation of research in relation to those aspects that research managers and stakeholders considered as relevant to their practice of CCA research.

4.3.1 Contribution to knowledge

Table 4.7 Contributing to knowledge

| Applying research to influence decision making |
| Investing in and managing capability          |
| Linking development patterns and biosphere   |
| Understanding and managing future risks      |
| Monitoring and reporting on performance      |
| Improving rural stakeholder literacy         |
| Providing feedback from stakeholders         |

Participants were asked how in their role as a research manager or stakeholder they were able to make a contribution to CCA knowledge. Each offered a unique view of their contribution to knowledge which demonstrated the efficacy of the selection of participants in representing different perspectives. Participants’ responses surfaced a range of views including investing in and managing capability, linking settlement patterns and the biosphere, developing measures for external performance, improving rural stakeholder climate literacy, and modelling to support decision making (Table 4.7). There were some areas of convergence in perspectives including influencing decision makers, encouraging conceptual integration, monitoring and reporting on internal performance, understanding and managing future risk and providing feedback from stakeholders. Nevertheless there were differences in how these areas were represented.

(i) Applying research to influence decision making

From two perspectives, one internal and one external, influencing key decision makers was a key aspect of contribution. There was a sense of acting in a political context, on the one hand in influencing policy directions through publication and on the other acting in a guardianship capacity to ensure the State was not disadvantaged. It’s notable that publication in this respect was a process in establishing reputation while the real influence, as noted earlier in terms of making a difference, was in face to face interactions.

“The only way we can influence policy – well it’s not the only way – but the chief way that the Australian Government or the State Government can build on the research that we’re doing is if we publish papers.” (M001)

“To influence [policy] design and to I suppose represent Victoria’s particular industries and their needs but at a Commonwealth level. I suppose from a slightly more parochial point of view to make sure we’re not substantively disadvantaged in comparison to some of the other states.” (S002)
(ii) Investing in and managing research capability

Research managers explained how they influence internal activities by directing the way research is developed. From one perspective this meant acting in a capacity to interpret research and make inputs to the department’s strategic goals as well as reviewing and supporting different types of research. For another it was also important to identify and make a case for investment where there was perceived market failure.

“I think when you're in this position you're in a very privileged position because you do get a very good broad understanding of, and exposure to work and science that’s happening in the division, you don’t know the detail, but you can bring people together in different ways and encourage them to develop concepts and sort of try and help develop that through. So certainly in terms of providing dollars for research, it certainly influences that.” (M004)

“I think this is one of the areas where there’s a really good story for market failure, so called market failure: public goods, the investment by government in research. But, having said that, and even though that is some of it, if you like, the policies of investment into research and development but if it’s strategic, if there’s public goods, if there’s market failure then the government will invest.” (M003)

Participants in roles of management perceived themselves to have a good broad knowledge in which they could potentially see links between areas of capability to direct into strategic research areas. This meant having a significant influence on how cross-divisional and cross-disciplinary research was framed. As one indicated, their responsibilities included managing capability according to emergent policy needs.

“I have the opportunity to invest in capability ... we might say we might need capabilities so I’m, to give you an example have spent probably the last three years about trying to build economic capability in our divisions. Initially they said no we don’t have that it’s in the other division and don’t tread on our turf.” (M004)

In response to the CCA research need there was a sense that modelling was important in working with existing knowledge and technologies and applying it in different ways. One of the research managers referred to the use of existing tools for modelling climate, e.g., with existing weather monitoring networks. An internal stakeholder expressed the view that policy makers were always working with knowledge from elsewhere and that their contribution involved turning existing tools to address climate change. From another perspective, attention given to developing new plant traits suited to anticipated changes in environments and generating new management models to support changes in framing practices.

“...all you’re doing is you’re applying practices that have been used elsewhere, either overseas or in other discipline, other, with other issues you’re turning those same tools and applying them to the climate change problem.” (S002)

“So at the moment we are putting out some information to growers about different cultivar maturity, how they should be managed, and we are also looking at running that under a future climate change scenario and saying, “Okay, if that happens, how would the management change under a future climate?” So it’s understanding how things are happening now, but also understanding what might change and what might need to be looked at, and with the modelling it’s very much we run from 120 years of climate data, so it’s looking at the probability of getting certain yield and probably having certain events that might affect the yield.” (M011)

“So we are working with climate and crop physiology for an output, so it doesn’t really matter which climate we put in there. So the climate change is part of what we do but it’s not necessarily recommendations we are giving to growers now, but we are certainly
flagging it with the breeders saying that this is what you might have to start thinking about, these are the sorts of traits that you might need to start thinking about.” (M011)

(iii) Linking development patterns and the biosphere

It was claimed by one participant that an interdepartmental perspective could play a role in recognising gaps in information and involving stakeholders. In this context, efforts looked at where change is occurring such as in new urban developments and applying that to a climate change context. Where there was a need they would contract research to determine where policy should be occurring, e.g., looking at water systems, settlement patterns and considering new options like recycling.

“[We look at]...how the settlement patterns can be supported by the water regimes that we have and in Melbourne we’ve got basically then it gets into the recycling aspects too. So that’s generally sort of where our thinking is, it’s the basic strong infrastructure indication as you mentioned transport as a major infrastructure, our water systems.” (S005)

There was also an interest, in contrast to the DPI focus on industries, in developing capacity for urban agriculture and also understanding how urban settlement was affecting the land and the biosphere in a way that mistakes from the past could be learnt from. There was a suggestion that planning for rural and urban infrastructure could become better integrated.

“We[‘re] sort of users and that’s our main role, is actually trying to suss out where are significant bits of research occurring that relate to the systems that we are actually interested in. And that is how the settlement is affecting the land and the biosphere and then of course how it relates to the mistakes that we might make that have climate change [impact] and they can get worse.” (S005)

In a role as a change agent a need was recognised for working between areas of research and adding an alternative perspective. This contribution was framed as the facilitation of conversations that could bring new ideas between research and sectors, finding links and expanding ideas on what could be done differently.

“...we’re bringing in alternative perspectives and new ideas, we finding linkages between things that a small pocket of interest or expertise might be doing. So that might be people working very specifically in a single discipline on the energy efficiency of a building, for example. Let’s make broader linkages from that and expand some of those ideas to the energy efficiency, or the energy intensity, of an entire city. So who’s thinking about that? And that’s where we see part of our role as being. It’s starting to ask those questions and getting the conversations going around some of those things.” (S005)

(iv) Understanding future scenarios and managing risks

The notion of recognising opportunities and managing risk was discussed from an internal and external DPI perspective. Externally this view of acting as an agent of change was added to by advocating techniques of foresighting to realise the possibility for doing things differently such as trying to figure out what threats might emerge over different temporal and spatial dimensions. For example thinking in different spatial scales such as the role of the individual and the subsystems on managing risk.

“...to figure out the threats in terms of short term, medium term, long term. So in recognising the different spatial horizons where some of these situations are arising. So in the short term you mentioned things like health, amenity and heat stress, whether heat effect is an example of that. I suppose impacts upon property values, particularly on coastal areas. Economic, social and environmental effects relating to fire and drought...” (S005)
“So an interesting idea there about the precautionary principle and cost and benefits and how we conceive of those sorts of ideas ... So thinking about the role of an individual within the very subsystems that we play a part in. Affordability of whatever in terms of production of carbon pricing, for example, if and when that occurs. Again at the medium term the rising cost of precautionary action, including households, at different aggregations of people, so individuals’ households all the way up to the entire nation.”
(S005)

By taking a longer horizon view the question of precautionary action could be better addressed through scenarios of possible events, impacts and adaptation; and using such planning techniques to anticipate the set of issues in a broader and deeper sense to improve accountability over a longer term. Like the earlier view of managers, this government stakeholder played a role in bringing people together to focus and discuss new ideas that might lead to the creation of new knowledge.

“Frequency of impacts. Threat of interruption to services. You know, electricity, power, services, transport services. Risk of capital flight, divestment of coal generation assets, social risks. Settlement transitions, for example. So you can see the, I suppose, sort of issues that are arising is broadening and deepening as you sort of taking that longer kind of horizon as well. Longer term you have things about cost of water supply, cost of energy, generation, risks of energy supply, planning for climate refugees, for example.”
(S005)

“It's starting to bring people together so new ideas can be talked about, new conversations can start to happen to address, you know, create knowledge, apply that knowledge across the various time frames.” (S005)

Internal to the DPI the view was more aligned to understanding risk as a causal phenomenon and in one case being able to exploit opportunities as they arose in a more dynamic and fluid market and climate context. From this perspective adaptation was about managing risks. However this was seen as a much more straightforward process of identifying barriers and information gaps. This approach suggested that a problem could usually be well defined and a solution found.

“...if it’s about adaptations [as] people managing the risk around climate change, it’s about identifying where there is a barrier, or where there is an information gap and directing research into those areas.” (M006)

(v) Monitoring and reporting on performance

The view that research contributed to the identification of causal relationships supported the view that research management played a role in developing concepts and ensuring that projects were managed, performances monitored and results reported.

“A lot of it's about asking the question why something does happen. What's causing it? But then, ultimately, it's about I guess part of my role is involved in discussions around some project concepts through to final project planning and development and approval. Then managing those projects and monitoring their performance and reporting on them, so involved in all stages of the project cycle: there’s key steps or milestones in that process.”
(M007)

This perspective of research management entailed working with other managers, putting together an investment prospectus and identifying priorities by engaging with project leaders. There was emphasis here on the process of management and delivery of outcomes according to concepts, comments and recommendations developed in the inception of projects. Performance was monitored according to a prescribed set of
expectations including six monthly reports such that projects are delivered in a timely manner.

Overall the process was evaluated as an improvement on the past, where there were better synergies within a division. However there was limited synchronicity with other divisions. Here the emphasis was on taking guidance from a higher level of strategy.

“I have to say the process is a hell of a lot better now than what it was three years ago. We have quite a different construct in it now and it’s got a lot of benefits. It’s far easier to build synergies between projects than it was in the past, particularly within the division. It's still not easy to build synergies outside the division because the different program assessment groups are not necessarily in sync in terms of the timing and the steps of the process. But they're all responding to the same high level strategy.” (M007)

Despite these strongly articulated efforts to ‘manage’ projects there were business and cultural impediments to realising the totality of the organisations research efforts. This was articulated as the lack of a ‘framework’ for linking the projects and divisions together.

“But it's fair to say that there's business and cultural impediments to stronger collaboration. That probably doesn't surprise you. ... I reckon the reason why we don't get the synergy and the linkages is because there's not the framework, for want of a better word at the appropriate level.” (M007)

In contrast to the perspective of internal project management and performance monitoring there was an alternative view offered of external government performance. This was a view aligned with evaluation of how effective government had been in implementing change such as environmental restoration or practice change as opposed to the internal performance efficacy of research organisation. From this perspective management was more outwardly focused than internally justified.

“This question of government performance on the ground drove the need for really good climate change information and to develop understanding of community capacity and to realise how the drivers of investment were looping back into the governing architecture. This view showed an awareness of how government could become more reflexive or aware of the effects of action taken.
“... So at what point do we need to incorporate adaptive capacity in to that? What do we mean by community capacity? When is climate change being fed in to that community capacity discussion? The other aspects will be climate change and biodiversity or climate change and land stewardship, management, practices: all of them will have elements incorporated there. They'll probably: each one: if that was an individual theme, like the land health and another one being community capacity, then we would expect that each of these would be incorporated in to the thinking for each of those themes.” (S008)

Greater sensitivity to how programs are adapting to changes represented a different kind of role for government in developing response capacity to change. This view placed government function in the more dynamic environment in which external measurement of governing climate effects was directed at where it can best make a difference, e.g., by contributing to adaptation or appropriately re-jig investments.

“So that’s an adaptive management perspective. I mean, I hope that we get to a point where some of the things that we do now, although historically they have been fantastic exercises in building community interest. So we do a lot of planting of trees, for example, under a range of programs. Very often, in certain situations, seasonal and so on, we lose a lot of those trees. So how are our programs adapting to that? Maybe a large amount of what we’re doing now is just not the right thing to be doing. I’m thinking about revolutionary change in that sense. Maybe what we should be doing is just looking at what plan: instead of trying to intervene.” (S008)

(vi) Improving rural stakeholder literacy

However the need for engagement at the ground level was critical to open conversation with farmers who were not concerned about climate change. While climate change was thought of as natural cycle of variability this view represented a limited incentive to act or adapt to the true risk that climate represented. Thus this stakeholder contributes to efforts to try and broaden the discussion and think of human-induced change.

“I guess we’re dealing with is a significant information failure out there because there hasn’t been a good solid engagement at the ground level. To help farmers who look at weather maps twice a day: they understand the weather and they’ve lived through this and yet they’re largely sceptical of climate change. So we’ve just got a survey of 1500 farmers that’s been done which is an incredible amount of data in it. But it’s basically saying 56% of farmers are concerned about climate change. But two out of three would say the current dry is just part of a natural cycle of variability and about 40% say that average rainfalls will return soon and the 56% are concerned about climate change and one in three accepts that human induced greenhouses gases are responsible for global warming.” (S009)

This perspective represents a gap in the current conversation where farmers are upset about emissions and see emissions as a constraint. They don’t think of emissions as an opportunity which hampers the possibility for engagement with the current science and policy discussions.

“...so there's quite a gap there, in terms of the current conversation at a policy and science level and that's where a lot of our rural stakeholders are. I guess we’re trying to help fill that gap and there’s quite a bit of catch up. There’s a lot of climate 101 and a lot of emission 101’s needed at an engagement level because we've seen farmers quite upset about emissions' constraints on agriculture. As they would if only one in three accepts that emissions are responsible for climate global warming in the first place.” (S009)

“So two out of three are automatically predisposed to not wanting any emissions constraints. When most of them don't think they have any emissions liability, because I think it's that 56% that consider the carbons in their grass and pastures is stored carbon. Now there is real carbon in there in pastures, but it's not the storage that's different. So when they talk of policy makers and researchers talk about carbon in the landscape and
getting paid for carbon, we’re talking about long term stored carbon in terms of emissions reduction, whereas when farmers think of carbon, they see tons and tons of it sitting there in their crops.” (S009)

(vii) Providing feedback from stakeholders

There were some in the sample that positioned themselves as people hearing concerns of farmers. For example one indicated that such concerns should be fed back into research design. This reflected a view that not a lot of research on needs passes through extension back into the organisation which was viewed as a failure in the cycle of research and development. Another interviewee identified structural issues that prevent that happening, particularly where it was hard to get interaction between the divisions.

“I suppose because people like me interact with farmers at the ground level, we’re really the people who hear what their concerns are, and that in theory should be fed back into the design of R&D. In practice I don’t think that cycle works very well because of the nature of the preparation for R&D projects.” (S010)

“...within DPI there’s structural issues that make it harder for that to work. So the research is done in a separate division to the extension. So you’ve got these hierarchies and you actually have to actively build linkages between them which takes a fair bit of effort because people are generally responsive to upstairs in their little silo and it’s hard to get the interaction between the divisions working smoothly and effectively.” (S010)

This was made more problematic where research managers felt they contributed to help stakeholders try and understand what the possible implications and opportunities of climate change were. They also played a role in providing feedback from stakeholders back into the organisation.

“...and I think what I try and do is help our stakeholders better understand some of the possible implications and opportunities that may stem from the changing climate and one of the things is then also providing feedback back from our stakeholders back into the science and extension effort. For example, the word ‘climate change’ itself riles many of our stakeholders, including many of the farmers, and so we tend to use the term ‘climate variability’ in most of our consultations and dealings with industry, for example.” (S012)

In summary participants described a range of areas in which they felt they contributed to research. There were aspects of managing capacity and brokering knowledge from other sources as well as occasionally commissioning work for specific purposes. Some took a broader perspective of contribution in which they felt they were linking development patterns and the biosphere while others felt that their contribution was directed towards understanding and managing future climate risk. Monitoring and reporting on performance of programs implemented was also considered to be an area of contribution to provide some accountability on return for investment in environmental management. This contrasted with another area of internal performance monitoring and evaluation, largely achieved through administrative processes of personnel and team research performance. Contribution was also seen in improving rural stakeholders’ literacy on climate change and emissions knowledge as well as providing feedback from stakeholders as a means for verifying the practical value of research.

4.3.2 Conceptualisation of climate change research

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<th>Table 4.8 Conceptualising climate change research</th>
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<td>Better understanding of environment interactions</td>
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<td>Recognising socio-economic consequences</td>
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<td>Improving capacity for shared responsibility</td>
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<td>Building local relevance of policy and science</td>
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<td>Facilitating new research relationships</td>
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Participants were also asked about the different ways CCA research was conceived of or conceptualised. Appreciating different ways in which participants conceptualised research can provide a basis for developing and accommodating change in research practice. For example participants’ concepts included better understanding of environment interaction; recognising socio-economic consequences, e.g., by considering the whole set of relationships between production and consumption; and adapting to changing environmental conditions. Improving capacity for shared responsibility; building local relevance of policy and science and facilitating new research relationships, e.g., through ‘planned adaptation’ were other thematic areas in which research was conceptualised (Table 4.8).

(i) Better understanding of environment interactions

Both groups described CC research as contributing to better understanding of interactions between biophysical and socio-cultural environments. However this was mostly expressed in terms of biophysical relations. There was a sense of adaptation as ‘building resilience to shocks’ in which research performed a role in finding win/win options in which action can be taken without regrets. This was closely tied to the need for developing efficiencies and better biological understanding of species-environment interactions. An alternative to this perspective of internal resilience of industry as a closed system was the view of looking out to the whole relationship of the system we have built. This placed agriculture in the broader context of daily existence and economy and what’s invested in sustaining that.

“...all the research we’ve approached, we’ve always approached it looking for a win/win option. That's almost a no regrets approach... if in 20 years time we find out that methane wasn’t influencing global warming, we actually are more efficient, we understand the animal better, we understand how to feed dairy cattle better and they're producing less methane and more energy in 20 years time.” (M001)

“It's looking at our whole relationship of how we deal in our daily economy and consumerism. And it's like the food situation. You buy the cheapest things at the supermarket, the home brand stuff, is all from either Brazil or Denmark. So it's honing that sort of daily existence and how we actually consume and live to the reality of everybody...” (S005)

Against these two perspectives of seeking stability versus radicalisation of the view of agriculture and development was a third view that not all was negative as some potential benefits could arise from increased carbon in the atmosphere. The facilitating new research relationships was aligned with this view that sought a kind of opportunism but also recognising the relationships between human directed activities and the wider environment had to be reconsidered. This was framed as opportunities for change with the potential to lead to new knowledge for adaptation.

“I think there’s also some good news stories potentially, which we’ve really got to try and dig out. For example, one is that plants grow much faster and bigger under high CO₂, its called carbon dioxide fertilisation effect... The down side of that is that relative to other components, like proteins and nutrients, they have more carbohydrate so, arguably, they may not be as nutritious.” (M003)

“I know we have got a range of research programs with regards to helping better understand the opportunities for carbon sequestration, to better understand the soil profile and how soil carbon is captured and stored, better understanding of emissions from things like fertiliser use, nutrients, better understanding of methane emissions from ruminant animals and how you can reduce the emissions by looking at better animal management and different feeding regimes as well as in the complex system.” (S012)
Biophysical perspectives framed the opportunities as connected to improvements in efficiencies and potential productivity gains from changes in higher concentrations of carbon dioxide. However from a socio-cultural perspective there was an ethical component of conceptualising research that was absent or marginalised in the case of improved productivity. It was clear that the impetus of change as a result of new knowledge was connected to the ability to be able to reflect on the situation and on whether current activities were sustainable.

(ii) Recognising socio-economic consequences

An interesting corollary to the better understanding perspective was that in which climate change was now seen as ‘beyond an environmental issue’ in terms of having a ‘significant economic impact’. This countered the traditional view of research as not just about finding a better technology ‘widget’ for doing things but in having to factor in all the complexity of downstream and upstream impacts of technology.

“But what's happened is we've gone beyond the biophysical changes and the impacts that that has on the environment and natural systems, to thinking now more about the economic and trade impacts and so it's a recognition perhaps that we've gone beyond an environmental issue to recognise that it’s going to have a very significant economic impact, I mean literally it impacts on our way of life, and also on our trading relationships and finally the government policy too will have an impact.” (S002)

“But increasingly we’re finding with climate change you can't, it's not a simple we'll have a better widget and we fix up the job the widget does, it’s all the downstream and upstream impacts that that can have, and so it’s increasingly complex that one thing leads to another to another to another.” (M006)

Another perspective offered was looking to the longer term as a beyond the immediate drivers of change, such as water constraints leading to efficiencies. A more radical view was the perspective of changing entire farming systems which included a need to understand what motivates a farmer to change. This framing of innovation moved from ‘not just a better widget’ to coming to terms with and coping with different way of doing things.

“So 90% of farmers have implemented some water efficiency practices and because they’ve had to implement a driver, how much [of it] is the planned adaptation? I sometimes think you can only really adapt if you know what it is you're trying to address. A lot of current response is to deal with the short term dry and a bit of a blip and there’s less of a response or acceptance of what we're looking at for the longer term.” (S009)

“We’re do changes for example the EverGraze system, you might have heard of, that, that is an entirely new farming system so we’re about changing entire systems for farmers, not just little bit's of it, and bit's, and part of it is trying to, well what’s the pathway for a farmer and motivation to change his system it's easy to do a little widget that might add a bit of profitability to your enterprise, but when we have to change the fundamentals of an entire system to cope with change, that's a different ball game, and that's one of the big changes.” (M006)

(iii) Improving capacity for shared responsibility

Another means for conceptualising research was the improving capacity for jointly recognising assumptions as a shared responsibility, for example, where water constraints and competition may produce innovations in practice. Another also recognised that there would be some maladaptive actions that make sense in the micro-scale but are detrimental to the overall security of resources. For one, the potential to increase
capacity could be realised by increasing the understanding of what drives climate variability and to potentially change the ‘literacy’ of farmers as to how they ‘read’ climate and develop capacity from that understanding.

“It’s very broad, I think, what some of my colleagues have been doing in helping the general understanding of the issues of the drivers of climate variability has been very profound and has had a very substantial impact in terms of just helping the literacy of our stakeholders with regards to some of the generic terms for main climatic patterns that impact on rainfall, for example.” (S012)

The idea of supporting farmers in making sense of their world was configured by framers as the ‘eternal optimists’ in hoping that something will happen. It was a means of looking to shift their perspective from a belief in humanity and a faith in nature to belief in nature and faith in humanity.

“So it’s about very much I guess drawing on their own experience to try and make sense of the world, and knowing that in the past we’ve been through... you know they’ll talk about the federation drought, or the 39’ or the early 60’s as periods of extreme climate, if you like, from which we recovered, and being eternal optimists they’re hoping that the same thing’s going to happen again.” (S010)

(iv) Building local relevance of policy and science

Research was also conceptualised as the building of local relevance of policy and science. This arose from a wider view that there was so much information that the potential for confusion in supporting agricultural adaptation was considerable. Another perspective suggested that there were no reliable sources of information and that trying to anticipate and predict under so many uncertainties led in the end to putting out messages that were not convincing,

“But we need actually that solution-making happening at the local and community and regional levels. So I'm not sure, I don't see much evidence of that, in supporting of that. The community's really great, we've got some great people. But it's a bit too centralised at the minute.” (S009)

“And the fact that there is so much information, people are being bombarded with so much information and don’t really know what’s reliable and what’s not and so that makes everything murky and muddled and, as you said, we don’t know really.” (M011)

“We can only try and anticipate and predict but within that there’s a lot uncertainties. So kind of putting out messages that aren’t convincing or don’t eventuate either because they are wrong or because it’s just not going to happen in that year.” (M011)

(v) Facilitating new research relationships

There was a cluster of views around facilitating new research relationships to start to open new areas of innovation. However against this view was the doubt of how much change can be anticipated and prepared for. Some felt the need for support and stimulus to think more creatively, while others believed that innovation was driven by really tight constraints. Besides this was a view that practical discussions around adaptation by visualising future scenarios were helpful to overcoming constraints and realising opportunities.

“I think we need some support or stimulus to think more creatively about what the future might look like and how to respond to it and to think about what the step changes might be. I believe a lot of innovation is driven by having really tight constraints... So a clear definition of a problem and nailing the underpinning assumptions related to solving that
problem so they can be constantly questioned and debated to see whether those assumptions that underpin and hypothesise the solution are still valid.” (M007)

“...I think it’s evolving, I think we’re evolving more and more from the terribly essential and critically important biophysical change to start anything about their impacts on complex natural systems, as well as built systems. I just don’t understand the interactions in, which has to be a very systemic approach, between these biophysical impacts and how they’ll play out in both natural and built environments, with quite different consequences in both. And indeed that’s where the added recognition that in some areas paradoxically there may be benefits from climate change.” (S002)

“...Better understanding, I suppose, of some of the potential opportunities to increase plant growth with higher carbon dioxide levels and those sorts of things and I know that the other element to that is better understanding from scenarios and climate change scenarios and this sort of ‘whiz bang’ visualisation and modelling techniques to better understand what the future might look like so that we can start having a practical discussion around specific adaptation and management strategies.” (S012)

The diversity captured here provides a view of internal FFSR management perspectives through quite distinct differences in concepts as technical policy advice, technological productivity improvements, impacts of improvements, and anticipating future events. On the other the internal stakeholders sought integration of research, better means for coping with denial and influencing decision makers with evidence of impacts. Those with an external stakeholding conceptualised research through a wider social responsibility in which greater capacity for action could be built for transforming to a low carbon economy and coming to terms with risks that were unmanageable.

This section has demonstrated the diversity of participants’ perspectives in conceptualising CCA research. It was intended to surface and shed light on difference as a way of developing a critical engagement of research management practice in relation to the issues, as seen from this small group of research management practitioners and stakeholders. In addition to the thematic areas found in interview responses, differences in participants’ views could be found in line with where they were located in the research framing as research managers, internal DPI stakeholders and external department stakeholders. A comparison of these groups’ conceptualisations is offered in Appendix 10.7. The perspectives captured have provided a basis to develop a set of conceptual models discussed in Appendix 10.7. Differences between those interviewed are linked through areas of rational, practical and social activity.

### 4.3.3 Stakeholders valuing of concepts

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A summary of participants’ views of how stakeholders valued different conceptualisations of CCA research is shown in Table 4.9. Before attending to these thematic findings, differences in orientations to valuing research raised in interviews are discussed. Participants indicated that the way research was valued depended on its relevance to stakeholders. Opportunities to influence stakeholders’ perceptions of research were seen as valuable. It was also understood how research was valued depended on what kind of stakeholder, their belief system as well as differences in geopolitical context.
“It depends on the stakeholders because, like you’ve said, we’ve got a massive wide range of stakeholders from bloody people that develop policy, it’s pretty important to them at the moment because voters know about it so it’s high on their agenda, is climate change.” (M003)

“Different stakeholders, there are different ones. So I think what I’ve talked about mostly is kind of government: say minister down to central agency policy maker, that kind of level: policy officer level. The other stakeholders, who are our statutory agencies and catchment manager authorities probably have different perceptions of them. I think that they’ve been in the main quite mixed and it depends on the geopolitics of where they are because they’re regional.” (S008)

(a) Difference in orientation to valuing research

The different perspectives of different stakeholders were noted more distinctly by one external stakeholder as ‘ministers, policy makers, policy officers …. statutory agencies, CMAs’ all having different perceptions. However this view of a general mixed set of perspectives was also seen to depend on the particular geopolitics in which they emerged. This was made real for this participant in the different set of issue and constraints across different regions, e.g., through a focus on the big drought and water shortages in the Goulburn Broken against Gippsland seen as least impacted.

“So if you’re in the Goulburn Broken which is a Shepparton irrigation district up there on the Goulburn River, then your focus for a long time probably has been on: this is a big drought, isn’t it? Kind of stuff. It doesn’t matter: it’s a drought. I mean, they’ll be thinking about allocations of water in to irrigation. But they have a very different view to say some of our CMAs in the south-west that have tended to be very interested in climate change for a long time and taken a lot of international and global views on climate change: different geopolitics play out, I think.” (S008)

“Gippsland don’t reflect much on those sorts of things at all as far as I can see. So there are some that are just: Gippsland would be a good example. They have probably different drivers in east and west, but I think Gippsland overall probably doesn’t have a strong view of our climate change. It probably feels in a lot of cases that they’re the least impacted so far. They’ve got a small irrigation area, but they’ve probably not suffered a lot from water limitation.” (S008)

Another measure of difference was that valuing depends on one’s belief system. From this perspective research was of value only if it helped farmers cope with climate variability. The sense here was that the overemphasis on denial frames the public in such a way that the opportunities for engagement are missed.

“So if we think about the farming community, I guess the value they place on the climate change research we do depends on their belief system about climate change. So if they’re in the camp that says, “This is not a permanent change”, then I guess they wouldn’t place a lot of value on what we do, unless it’s also going to help them cope with the climate variability which they do acknowledge is happening. So if they see a bit of research that comes out that then we can put it in that context then it will be valued. If we try and tackle their current belief system then I think they would tend to devalue the research as being not really applicable to them long term, and that’s not to say everyone’s in that camp…” (S010)

“The dry they’ve had kept taking its toll in terms of reduced capital and the reserves people have is dwindling and different things are going on. It’s a very different story in agricultural terms of - probably saying essentially 50% of farmers out there are probably terminal at the moment. But the other 50% have a really exciting future ahead. So we’ve got to get better at segmenting. I don’t mean talking about climate change, it's not everyone who’s after a technological solution, which is often a risk for the science
organisation, so we just get a better wheat variety. So if 50% of the farmers have a better wheat variety that would be fantastic and a part of them.” (S009)

It was clear that a diversity of perspectives existed which required different approaches to engaging stakeholders in different contexts. For example there was a sense of climate change still being a new issue and they had not yet got a good handle on how people were responding and what was changing in the nature of Victorian farming. There was an inherent focus on growing industries and getting optimum results through best practice.

(i) **Tangible influence on decision making and action**

One of the research managers was concerned whether or not the evaluation process was actually capturing a realistic picture of what influence research had. He was concerned where views were ‘coloured by perceptions’ rather than valuing research as influencing something ‘more tangible’ such as decision or action taken by stakeholders.

“Sometimes our evaluations I don’t think are quite as accurate as they should be and probably should be more focused on interviewing the policy makers to understand how the work that we’ve actually done has influenced some tangible thing that they’ve actually done.” (M001)

DPI stakeholders and managers recognised a need to deliver short term benefits that supported longer term aims of adaptation. A range of possibilities fell within this framing including realisation of ‘best practice’ in land and water management, continuing focus on production efficiencies, and sustaining businesses through risk management.

“Now that might not be something that they are worried about if they haven’t been able to sow or they wanted to clean up weeds in a particular paddock, something that they’ve needed to delay, but it’s helping them make decisions about what they do knowing what the consequences are. So we are not telling them what they should do, we are saying this is a whole range of things you can do and these are the outcomes, the probability of achieving these outcomes if you choose that. They can mix and match themselves, but I think that’s powerful. We’ve had fantastic feedback from growers. We’ve put out some fact sheets and things like that and it’s been very well picked up.” (M011)

(ii) **Changing behaviour precedes changing attitudes**

From another perspective the challenge for valuing research was to get to a point where behaviour has shifted ‘as if climate change is real’. It was also noted that behaviour was a more important indicator of change than whether people explicitly recognised climate change to be occurring. Part of the complexity of managing research when people were in denial suggested a greater need for helping people cope with change.

“So you’ve got this paradox that the grain growers in the Western District, two thirds will say no we’re not [experiencing] climate change, but you look at what they’re actually doing and how they’re changing their practices as a result of 13 years of low rainfall, they’re actually doing the right things. Their behaviour is as if climate change is real. Therefore in essence the challenge for us is to really to try to change some of their behaviours, to encourage them to pursue adaptive processes that increase the productivity under climate variability.” (S002)

This perspective was established more firmly as a belief that ‘change in behaviour precedes change in attitude’. In practice this meant containing scepticism and finding other ways of gaining receptivity. For example there was limited discussion of industrial agriculture’s strong dependency on fossils fuels and their by-products amongst DPI participants. At the same time there was a perspective that represented the science of climate change as contested. From this perspective having better connection research activity with ‘key clients’ understanding of local conditions was thought to make them ‘more receptive’ to new technologies and practices.
“...you have got at least half of your key clients, if you can call it that, from a Department of Primary Industries perspective, who are not perhaps convinced that climate change is as a direct result of man-made greenhouse gas emissions and therefore you just know that you have to understand that, and you have to context the research activity so that those clients can better understand the climate debate and are therefore probably going to be more receptive to the new technology of management practices that may help them reduce their emissions.” (S012)

There was one view put forward of a more divided camp in farming communities where people on the ground vary in their response. This represented different degrees of commitment to reducing emissions and subsequently placed different values on research. It was an indication of where the ‘climate story’ gets to a point when people realise it’s not just a continuation of past patterns and there is more sensitivity to the evidence that things are changing.

“At least two thirds of our community of interest out there who basically aren’t in the camp of saying that climate change is something that’s permanent and that we can do something about. So if we’re producing a bit of research that is about reducing methane emissions from sheep and cattle they might say, “Well what are you doing that for because this has got nothing to do with climate change, it’s due to sun spots”, or some other natural cycle that is causing the weather to be what we’ve been experiencing for the last decade.” (S010)

“So there’s that camp, and then there’s also people in every group that I talk to who are right on board and saying, “This is a serious problem. I understand what’s happening and we’ve got to do something about reducing the rate of CO₂ build up in the atmosphere in order for us to make a difference, or to ameliorate or reduce the impact of what’s going to happen next decade and the one after, and the one after”, so those people would place a higher value on what we do.” (S010)

These differences were made more concrete by a survey conducted in the Western district that revealed a ‘paradox’ in which stakeholder don’t believe. The view of change was as an expression of extreme climate variability that drew on historical precedent. Farmers’ personal experiences and family histories were raised as a localised awareness of cyclical changes in weather and seen as part of normal patterning in climate.

“The paradox is that two thirds in a broad bush way we did a survey of 1,500 farmers and in a broad bush way two thirds of our stakeholders that’s roughly, 36% don’t believe in anthropogenic forcing of climate change, probably two thirds, and indeed may be sceptical about climate change itself. They see climate change as merely an expression of extreme climate variability, and they’ll draw on historical precedent and records and say look yep you’re saying this is climate change, but we can tell my great grandfather drove a Morrie and an ox and cart over the Murray and my father, grandfather lived through the drought in the late 40s, my great grandfather went through the federation drought.” (S002)

(b) Stakeholders valuing of concepts

Research was seen to be valued was through ongoing focus on production efficiencies as well as means of building resilience through managing risks. However there was also a recognised need to understand the complexity of circumstances in which farming resilience might be realised. Further areas of where research was thought to add value emerged through understanding conditions in which innovation was optimised, developing dynamic modelling capability across interacting systems and facilitating a shared vision for research investment.

(i) Focusing on ongoing production efficiencies
Best practice was seen as the art of ‘staying in business’, for example, through productivity improvements and reduced use of resources. This framing was, to some extent, dependent on the imagination of the individual and how successfully they can remove themselves from the cultural constructions of the past. In another example noted earlier one of the stakeholders had stressed the importance of ‘de-coupling’ from the traditional model of economic development addressing the matter as a concern about social structures. However here the view was directed at the individual where staying in business meant being ‘smarter’ in the way agriculture used and protected the resource base.

“A lot of it’s around essentially best practices geared to productivity, sustainability and ability to ostensibly stay in business, and so it’s really selling more as: these are ways to improve your productivity, reduce your resource use, reduce your input cost. It’s really is, this is a very long, age old story of that increase in productivity. So it’s being able to produce more with less, a bit smarter about the way we use the land, the way we protect the resource, and by and large they respond quite well to that.” (S002)

“So climate is seen to act in, with adaptation for climate still has to interact with all the other uncertainties which bounce around it, like commodity cycles. So to me, it’s a bit of an example of: you can adapt to the climate but has that adaptation made you more resilient to other shocks?” (S009)

There was an important shift in this discourse that government was not just viewing climate change as an environmental problem as it has ‘real economic consequences’. Yet it was still interacting with all the other uncertainties such as ‘commodity cycles’ and in which ‘building resilience to shocks’ was presented as a general anthem to business sustainability.

(ii) Understanding the complexity of the situation

On the other hand there was a strong need to get to grips with fossil fuel consumption and come up with alternative sources. In contrast to the view that whole systems might be better to change there was this sensitivity to making a gradual transformation from economic dependency on fossil fuels or transformation of economic progress to something more sustainable. New models of development may come up with an alternative that is desired. Thus the reason for processes of multi-stakeholder engagement was to get agreement on what’s desirable or at least discussion on what is not.

“...our fossil fuel resources, which [are] one of the drivers of climate change, are not infinite. Particularly the liquids, particularly crude oil, and sooner or later as a global community we have to get to the grips to the fact that we can’t continue to consume liquid energy in the way we have done in the past, so we can come up with some alternative source, and preferably one that we really want would be nice, then we won’t have to worry about running out and so on, at least for the near future.” (S002)

Treating the issue with sensitivity was further substantiated by the view that farming requires an optimistic outlook to continue as its does under conditions of adversity. There were examples offered through realisation of production efficiencies, resource use efficiencies and risk management that suggest increasing an ability to ‘exploit opportunities’ was being fostered.

However the idea that it was too scary to conceive of long term climate change represented farming as isolated from wider social and community support, and from which tradition had valued the exploits of men on the land as ‘man’s ability to harness the environment [and] subjugate it to whims’. However there was another set of questions
underlying the need to cope with change and in this sense climate change was seen as a catalyst for acquiring a new set of life skills.

“But there’s another reason why we think this is, and perhaps this is where it gets a bit more subtle, and that is for farming in a sense it’s, by it’s a nature it’s requires a very optimistic outlook. Because farming is, it’s really man’s ability to harness the environment, subjugate it to our whims to give it to things we want, so we can grow our crops. Basically breed our animals etc. So I think there is a great degree to which farmers are scared of acknowledging climate change is real, because as they said to me if I thought climate change was real, I’d give up now. ... But if we’re going to be in this water constrained environment, I’d give up now.” (S002)

“So I think there’s a bit of, it’s called psychological denial, which may not even be sort or intellectualised consciously, almost an unconscious, I just don’t, it’s on the too scary to conceive we could be in this long term climatic change. It’s a lot easier for me to come in and say, it’s a really crap time, but it’s going to improve. Hang on in, things will get better.” (S002)

“Are you ready to take it on, there’s a bright future for Ag but you are ready? But if you can’t say yes to all of those questions: you know, if you’re not happy doing what you’re doing, or if your family’s not supportive, or if you’re not actually making any money out of it and if you’re going backwards, a new wheat variety can probably get what you’re after, but it’s probably a different discussion we needed to have. I think the more we look at adaptation and dealing with farmers and what’s happening, if there’s a much greater need to help people with coping with big change, climate is really just really an accelerator and a driver for everything else.” (S009)

(iii) Conditions through which innovation is optimised

Another view offered was that research was better received if seen through the eyes of farmers and not trying to fight through the apathy but trying to give them some enthusiasm on possibility. This entailed providing a sense of choices on what they can do to maximise future choices. However the more strongly that entrenched positions dominated what was happening the less choice there was for individualised agency. For one stakeholder this meant breaking through the ‘cognitive dissonance’ to realise climate change was real as the result of taking adaptive actions. This framed change as a sub-political process in which stakeholders were reacting to the effects of change without realising or applying pressure to change the policy system.

“And so I think we, it comes down to working with our stakeholders, we’ve got to sort of, I see it a bit through their eyes and on that basis, the message you might use is say people are more apathetic urban city, urban dwellers, because they’ve got their busy lives and you’re trying to fight through the apathy and the old this is serious and get real isn’t going work with these people, because it’ll just drive them further back into their sort of shell. They’ll just retreat a mile deeper. You’ve got to really come at it from a different angle.” (S002)

“...whereas after a certain period of doing this, after a number of years of these practices, they’ll be a bit of cognitive dissonance because basically they’ll all start to say well hang on, yeah I’ve done all this and I’m saying climate change is not real, yet I’ve done x, y, z, and at some point they’re going to turn around and say well I’ve done all this now, maybe climate change is real, because I’ve realised now I’ve come this path, which really wouldn’t make sense if I didn’t, if I thought climate wasn’t changing.” (S002)

The situation for a policy maker was seen as different for a vegetable grower who has other pressures on his or her mind. The worry about ‘tomorrow’s prices’ meant that they would value research only as something that can add value to their bottom line. In this sense research managers were trying to mediate wider benefits with the immediate gains of farmers as contributing to public values. However there was contradiction here as with
other perspectives on whether growers actually care about the quality of their contribution to social life beyond the immediate concern for returns.

“People like the vegetable growers wouldn’t care a continental about climate change. What they’re worried about is the price of broccoli in the market tomorrow. But, having said that, when I presented the concept of Vital Vegetables to them, they loved the idea so we went back to them and said, “Look, it might be a way to add value and differentiate your crop based on health benefits”, they might change.” (M003)

Furthermore there was another dynamic in which there was a re-conceptualisation that constraints can be realised as opportunities, through which ‘discovery’ can be made on cultural practices that are not sustainable over a longer term. Presenting this as an opportunity to reap some future benefit was a counter position to the view that there was too much risk in the current system. Against this perspective stakeholders were viewed in ‘a state of ambivalence’ while the organisation was trying to broker projects, they were still caught up in daily issues.

“I think a lot of the stakeholders to varying degrees are still in a state of ambivalence or denial, as they’re caught up in the day to day. So some of the research for a lot of people within the organisation: they’ve been trying to broker projects related to climate change with various external agencies. It’s a journey we’re on, because a lot of them are grappling with the pro-climate change against the issues of the effect today.” (M007)

“Because some stakeholders, like the policy people are really concerned about the long-term and they make laws that way but, really, I think the industry itself, as good citizens, they’re concerned about long-term impacts. But as far as their businesses go and what they’re investing in, as far as <inaudible> goes I think - it’s just my view though - that they will be working on things that will show a short-term benefit.” (M003)

“But in that respect one of our challenges is to join the immediate and the long term together, whereas we see it as separate, presently. So I think that’s a real issue. It becomes quite important, because if we’re going to make step change, we’re going to have to be bold in the research that we do. If you’re having trouble, researchers live by winning projects. If they don’t have projects, they don’t have funding. If they don’t have funding, they don’t have a job: it’s pretty fundamental in those ways, hierarchy and needs and it’s pretty brave to be bold.” (M007)

(iv) Facilitating a shared vision for development

While collaboration was valued it was clear from participants that research was valued in different ways by different stakeholders. As expressed there was a ‘different spectrum from different sections of society’ in which it might not be possible to distinguish on a ‘sector basis’. This reflected the real complexity of relationships in communicating and valuing research in which non mainstream voices get lost, even where they cross over areas of political representation. For one stakeholder this was addressed through participation and maximising social engagement in research.

“I guess it would be more than sort of almost like a social or participatory research. And I’d prefer to use that word, participatory research where we open up the research on climate change and we let the maximum amount of people participate so that to me that’s the way of actually gaining a lot richer depth of ideas that we might want to pursue, or that might be coming up.” (S205)

This created a different kind of networking for maximisation as opposed to interest based networking. This was also represented as vertical and horizontal integration of the system of government which was part of the whole-of-government discourse expressed in FFS (p. 26). Here an external stakeholder perspective noted the importance of identifying priority and cornerstone capacity in integrating government.
“There's a little bit of depth in some silos, but [my colleague] mentioned there's very limited what he called vertical and horizontal integration of the research effort. I think that's an interesting point to make there. Down here he said research and some ways identifying priority, cornerstone capacities, whatever they might be. So we need to enable the market and wider communication in response. So whatever cornerstone capacities are, and we might not really know what that is just yet, but some research around developing cornerstone capacity in comparison with, for example, what he called tackling the bubble up change or something.” (S105)

This was part of the process of generating a shared vision for government and to enable market and wider communication in that deliberation. One such capacity is to bring awareness of your own personal perspective. In this case lived experience is being used as a guide for rationality through the conditions in which abstraction is no longer reliable as it misses the complexity. This means a reliance on subjective intelligence in asking collaborators to consider how we frame research questions as this will influence the nature of our response to climate change.

This stronger deliberation on research value for transformation was contrasted to that of one of the research manager in suggesting that if making the ‘step change’ they have to be bold in research. Where their usual investors are focused on the issue of today they is a sense that they need to link up so they can see relationships between today’s investment and tomorrow outcomes.

“All the people that are making the investment decisions are focused on the issues that hit today rather than the ones that are a bit further out. So constructive projects and ideas and responses in a way that people can see that they can address outcomes in a time-frame, they can see that as an important challenge. Because it takes a while for research to get there and to get results and to get outcomes that people are happy. So I think that's one of the consequences of the way I see it.” (M007)

The newness of the area of research into climate change had the tendency to bracket it with other programs of trying to grow industries through best practice. Yet there are different meanings for each of them. This is consistent with view above especially in relation to emissions and in relation to resources constraints. However from this perspective there is limited scape for seeing parts of Victoria as a potential carbon sink having the forestry industry growth there. Mallee farmers are quite different with a 50:50 view of division with some leaving and others coming in. This gives rise to consideration according to one stakeholder of how farmers differentiate types of action they can take to avoid or mitigate climate change.

“Being a part of agriculture is always saying it just gets better and more efficient at producing more of everything. But the 50% who, a new wheat variety might help keep them in the game but it's still part of the defining cycle. So there's a broader audience out there which need another discussion, which is about - I talked about it a bit. You know, it's higher order questions: you know, are you happy doing what you're doing? Is your family supportive? Are you making enough money to sustain yourself now and in the future? There's a couple of other questions. But they're much higher order things, in saying, when you come up with the latest task plan and come at it from all of this stuff. But I'm not sure if that's how you are actively planning your future about: it's not just climate change and changing policy settings and changing problem markets.” (S009)

(v) Developing dynamic modelling capability
There was a view that CCA response pathways are going to be the same as they are for any shock. Here there is a sense of choices for those in particular situations. Its not that CCA research is providing farmers with ‘options’ but that they are in different situations and will use knowledge in different ways to secure their own sense of future. This is not
necessarily that prescribed by science-based approaches to generation of options. It is re-adjusting how agriculture is financed with a sense of challenge to the view that ‘government will come and save us, because they have in the past’. As indicated by one stakeholders, to ‘make sure that people are actively choosing a future and that everyone has a choice’ in a way that choices are not forced upon them.

“So it's not about [how] people get to that point, they're driven there because of climate related emissions, but it's big change we're talking about. It's not a climate change program, we're actually talking about how do we deal and support so that an industry can make it through major change. It's threatening to people too because it has a wider audience and you don’t have to be a climate change believer to try and think about the future and if you're up for it. Because I think the future is going to be very, I think we can still increase the value of Victorian agriculture. But it will be different. And it won't be with everybody. That's probably the same with agriculture in 1950, it's going the same, but a bit more ruthless. So how, and who does that?” (S009)

This reflects on earlier comment on the importance of building up human capacity for coping with change. There is an opportunity in CCA research to shift the relationship between government and citizens. However this is not just because of climate change but because of what has preceded it. All the discourses and research efforts towards understanding ‘best practice’ and ‘risk management’ are tied to a history of increasing market liberalisation and government rationalisation. Furthermore it has become an ‘issue’ because of social and natural circumstances changing for what was perceived to be improved standards of living and wealth.

According to one view, modelling work and probabilities opens the possibility to see the penalty of choices and by balancing off of one risk against another. However all models have designers and the question is whether designers have an adequate understanding of different contexts to create a reliable model that works usefully across a range of contexts. On the other hand if those who use the model are the one’s who design it they can see the impact of actions taken based on those models. This can, in turn, be fed back into the model, not just helping farmers understand the consequences of their decisions but also identifying weaknesses in the model.

Modelling was seen as a useful tool for helping stakeholders such as farmers and plant breeders make decision about what they do by knowing what the consequences are. This includes helping make judgements that can anticipate what cultivars to grow, when to sow them, when to apply fertilisers and so on. Its helping stakeholders act with more confidence or in a purposeful way. However the model is being tested against reality as it unfolds and providing a rapid appraisal on how well it represents what is happening in reality.

“Yes, well as far as the growers are concerned with the modelling work we have been doing, and again it is very similar to climate change because it’s looking at the climate and looking at probabilities of certain things happening. We’ve been looking at the probability of getting a yield with different management practices so that they can see quite clearly that the penalty they will get if they go for one option over another, or the potential, they could get a lot lower yield if they sowed their crop in July. We’ve been able to put a bit of a figure on that, “You will get a 50% reduction or a 30% reduction depending on the cultivar.” So they can see what the impact of that is.” (M011)

There is a sense that this is enabling stakeholders to act with purpose by measuring practices against desirable carbon neutral practice. It requires more restraint and purpose in action and ‘not to feel bad about it’ but to reconcile it against the situation. This work makes the best judgement in relation to other considerations, ‘as long as you know we are keeping that even balance’. It means finding the option of spring sowing or something
else if the climate is right. In some sense this is putting more variability into the conceptual models of farming by removing the expectation of good seasons all the time.

It’s also helping breeders to make marketing decisions, which are notably different from the government-based plant breeding decisions of the past. Commercialisation impacts the way knowledge is generated because of the different social conditions in which its demand and management is determined. At the same time there recognition of the need for a longer term outlook in which breeding programs can be geared towards the longer term future. Developing this knowledge capability on how particular traits respond in the environment was thought to improve modelling and ability to predict what might happen as environments change.

“It’s a big gamble for them to put something out there and it may or may not work, it might not take, it mightn’t be managed properly, so they are not going to do that. We are working very closely with the breeders to get some of this germplasm and evaluate it and let them see what the potential is for them as a community. The breeding programs aren’t in government areas now, they’re all private industry, so you tend to not get the diversification of crops and varieties because it’s too expensive to do that research, it’s too risky, and again with that modelling, looking at how they’re going to perform over the landscape, it’s important for us to know is that going to be the same case in 2020.” (M011)

In summing up there are implications for DPI having closer contact with how research is used which may provide an opportunity to see where research was and was not meeting its desired goal. This may also begin to develop an awareness of how research was generating change and, if not, understanding what, in the environment of its application, was unanticipated. DPI may benefit from providing measures for monitoring and evaluating of the effects of research or its impact. This could open up opportunities for learning from sociocultural and biophysical constraints and the review of underlying assumptions such that they better reflect understanding and practice in more complex real world contexts.

### 4.3.4 Research linked-up

#### Table 4.10 Linking research activity

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A summary of responses to the question on whether research was linked up and if not why it fails to be connected is given in Table 4.10. Linkages were viewed in three general ways as made through people, elements and networks. Linkages through people were thought of as the interpersonal connecting up of people, that hadn’t typically come together as a means of finding creativity and innovation. The second way was the linkages between elements in the agricultural landscape such as water, carbon and temperature or the interactions between plant and environment or animal and environment. Thirdly the linkages were seen as connections between researchers or social networks that provided the context for research integration.

** (a) Formal and informal research networks**

There was a sense of building a wider social network that formed a bridge between agricultural research and practice. Some linkages were viewed as a facilitated form of connection in which people were brought together that did not typically interact. This view
configured humans with the tendency to ‘hang around like-minded people’ opening the
question of how you get people together that wouldn’t normally interact. This stakeholder
had witnessed the enthusiasm that arose when diversity of knowledge was brought to
bear on a problem and understanding of it.

“As humans, we always tend to want to hang around in like-minded groups, but that role of
how do we get that mixing? We don’t have to stay with that but often as a role, here’s
some people that need to hook up that actually have all got a similar vision, in terms of
improve their region or individual response and understanding of certain things. But how
do you bring all of their knowledge and they add value from each other and that
interaction’s going to be really good: it’s about people. But how do you make that? Often,
what’s used as a ploy to do that in funding wise, you’ve got to show that you’ve got a
partner to get the money and that’s sort of works in a bit of a fake way.” (S009)

“I think that's some of it we are looking at the new industry development about how you
make some of those connections, because often people who are ready to go are a bit
isolated. How do you try and bring people who collectively source and who herds them
together in the first round?” (S009)

(i) Research networks focusing on national integration
There was application of research ‘design’ process operating via a national strategy or
collaborations for climate change between government, industry and research. At the
same time some government funding has forced some national integration, e.g., on soil
carbon and adaptation as two key areas. Further links were seen in data being fed up to
national approach, e.g., on methane and nitrous oxide emissions. However there was no
mention of what studies were occurring internationally in this area and whether Australia
was taking lead role in this regard.

“So same thing around climate change, there’s that conversation that’s happening at that
sort of level. Then you’ve got I guess the DAFF recent climate change funding which is
really forced some national integration, the soil carbon is one where all states are tapping,
using the same protocol and all the data’s being sort of fed up to a national approach and
same with different areas around adaptation for the livestock industry and they say the
nitrous oxides from soil emissions is another project. So there are those sort of
connection points, but and then you’ve got the CRC process as well, so they’re the basics
in, there’s a future farming industry.” (M004)

Linkages were also visualised as a network of ‘connections points’ that gave less
attention to processes, although one also commented on obvious gaps and duplication
requiring people to talk about the issues. Some examples of that were the Climate Ready
Showcase and workshop between energy and agriculture researchers and managers.

“They’re the same although there’s obviously gaps in duplication and frequent needs to
get people together to talk about issues, and particularly across, the climate change
showcase across different divisions within DPI. Today is another classic between energy
and agriculture. Those sorts of areas there tends to be a lot more linkage.” (M004)

(ii) Different types of linkages and knowledge demands
Another area in which linkage was described was that where policy agendas drive
another sort of linkage. At the national level various types of networks were an attempt at
linkage that combined national processes with state agencies, CSIRO and universities.
There were also linkages across industry perspectives in defining leadership roles in
certain areas. For example Victoria had taken a lead in dairy research while other states
took up the lead on other industries.

This again is linkage thought of in physical terms rather than conceptual terms and yet it
is not clear whether there is any linkage across departments. Participants that were
external to DPI had noted past interactions in which they engaged in collaboration or had participated in workshops. However one conversation was that an interdepartmental body formed for VCCAP implementation suggested no need seen for anything else to link up VCCAP activities between departments. In practice they rarely met. This was partly a demonstration that there was weak commitment to this linkage.

“And then some of the policy questions are sort of asked, demand another level of linkage as well. Beyond DPI, there’s national type networks that are having a real go at linking. So you’ve got the CCRSPI and the PIAN network that are, so CCRSPIs driven by an agricultural industry basis to really look at what’s happening, and so there’s not anything and try avoid duplication and build synergies etc. PIAN’s much more cross industry, not just agriculture, but really focusing on climate change, adaptation, so you have those sitting there of which DPI is a strong participant, particularly in CRSPI.” (M004)

It was noted here also that a national research agenda was being shaped according to state industry strengths where different states take the lead on research. This results in a state-based strategic research investment from which findings and outputs are expected to roll out in other states, regardless of issues of context that might arise.

“You have the national R&D agenda process that’s going on where all the state agencies CSIRO and some of the universities are looking at who’s doing what and how can we actually build capability in certain areas, so at the moment it’s going from an industry perspective, and a cross industry perspective where the individual organisations are putting up where they, whether they’re going to be lead agency, if you took the dairy industry for example, Victoria’s putting up their hand and saying we’re going to be a lead agency for strategic and applied research for the dairy industry. Whereas other States might say okay we’ll be a secondary, so we’ll take the strategic research from Victoria and then do some application stuff.” (M004)

(iii) Plethora of sources means information overload
At the same time this was in spite of the view that researcher had been talking to each other through networks to ensure there were not potential duplications. From the perspective of stakeholders in farming and communities however there was a view of information overload. However it was also noted that there are a lot of stakeholders in climate change research that are likely to have different knowledge needs. This can result in different farming of CCA research which confuses those affected by a range of policy issues.

In one example the CMAs were running forums at the same time as DPI and one of the local climate change advocates had found a hundred separate projects of things happening in their region. It was acknowledged here that climate change does impact in different areas of people’s lives, which can easily result in rural communities becoming overloaded and confused. Having said this DPI was thought to provide a sound interface for sorting through information and structuring it in a way that could support different knowledge needs without leading to confusion on climate change.

“...DPI does pull together a lot of the desolate bits of information, and put it into that consistent interface between government and the community, but by the same token, because there are other things happening, and there are people running workshops and seminars and inviting all sorts of people whose credentials vary widely, I think it’s easy for rural communities to be overloaded and also confused about what they should believe about climate change.” (S010)

(b) Recognition of new relationships through research
From another manager’s perspective importance was given to recognising relationships as a result of working together. For example work exploring tannins in grapes led different thinking about the possibility of using tannins in livestock feeds to reduce methane
emissions. By working in problem areas not having been worked in before, with other DPI researchers, meant they were generating novel understandings on how to reduce greenhouse emissions.

There was some effort to focus the skills of researcher on one case study to better integrate the different disciplines. It was anticipated that this integrated understanding could then be mapped over to different statistical divisions and industries within those divisions. The goal in this design was to get greater collaboration between researchers to work through a joint meaning of the problem focus. There were benefits to this approach in building capability in integrated or collaborative research amongst different disciplines, however the reusability of outcomes would depend on the context of other cases and how well they matched the original case.

“So a case study of a wheat farm outside Hamilton in western Victoria where we’ve all applied. So we’ll do some biophysical modelling and then straight away the biophysical model has to work with the economist to say, “What’s the economic outcome of those different biophysical modelling scenarios?” Filter that through the social research and then put it all through three scenarios. So you’re sort of forcing the team to actually work and there is no silos involved. They’ve got to work on one problem and define that problem, from their perspective but not in isolation. That’s a challenge, a big challenge to get people to move out of component thinking into a more holistic way of looking at problems. And climate change brings that.” (M001)

This was not the only example of exposing gaps in knowledge in the process of collaboration. One manager was enthused that there were great opportunities for synergies between different areas of research that climate change has opened up. From this perspective climate change was seen as a driver of innovation. New research concepts had emerged by moving out from thinking in industry sectors. An earlier attempt to link up plant and animal sciences, e.g., in understanding photochemical impacts on nutritional qualities of plants to pass on to animals through feed, was resisted. The importance of taking time to think through the possibilities was noted.

“So we are starting to work together and, in actual fact now that I think about it, it’s because of the importance of climate change and the policy development around climate change. But I still think, if we sat down and thought about it, but we need time to think about it, we’d find a whole lot of gaps like that where there are is much greater opportunity for synergies in our work. As I’ve said, we still tend to think down our industry lines in grains and horticulture, livestock, et cetera.” (M003)

“I’ve said, “You know, you should get into this” you know and look at the phytochemicals in the feed and how they impact on the health and nutritional value of the meat a whole lot more. And I think there wasn’t much interest and I guess there could have been good reasons for that but all of a sudden, because there’s a really important bit that affects mitigation of greenhouse gas emissions, and all of a sudden we’re actually getting some collaborative work going. So I guess it’s just there’s got to be a driver for it and, if there’s not, irrespective of how good an idea it is, there’s no sort of policy or industry driver, then it doesn’t really happen, maybe.” (M003)

However there was concern also about what role government and research could play in recognising and supporting the emergence of such new relationships. There was concern that such new relationships were not yet established enough to have a lobby voice and influence on policy making. Against the urgency of action needed to build adaptive capacity there was recognition of finding opportunities to nurture and fast-track experiences of positive interaction amongst people. The focus in this regard was making sure people that were willing to take action on climate change have got the pathways to succeed or removing legitimate blockages to enable change.
“We’ve got a couple of examples where it’s been really valuable because when you're looking at new things, it’s not really tend to be well networked, those, frontier sort of stuff. So how do we create those new networks? Networks which will harvest benefit, not all of them work. But where it does work, it’s amazing. An example is some of the new carbon industry guys perhaps being interested. Initially, they know they’re all competitors, but they don’t have a common voice. So we ran some workshops with them and they really appreciated getting together and they have a lot of things in common and keeping up the policy stuff has been really good. But they’re not in an established enough industry yet to have their own lobby groups.” (S009)

“Across from the whole climate industry there’s a lot of potential areas. How do we bring these nodes of possibility? How do we nurture and fast-track that? So I’ll often focus on how a lot of people don’t understand climate change and risk and the emissions challenge. At the pointy end, we have enough people already that do and a real challenge is making sure they’ve got pathways to actually get on and actually make the change, because if they haven’t, there’s no point herding everyone else into the room. If there’s legitimate blockages or reasons why people are really concerned, they really understand it, they want to make the changes - if they can’t do it, we best do our pilot group to make sure that they’ve got the pathways to go and achieve and to manage the risk.” (S009)

(i) Reflect on relationships and redesign development
There was some discussion around metaphors for development in which science was prioritised by a particular focus and at the moment its economic growth. From this perspective the way research was prioritised caused or created certain connections and disconnections between humans and their environments. This was framed as a desire to decouple that where models of development can either constrain or enable different ways of thinking and responding.

“So it’s like if we look at our economic system and the way it operates and how that is currently coupled to the global climate system as well. So there’s a strong coupling there right now. So how can we sort of de-couple, or break the nexus between that and that’s going to be something that, you know, probably will need to occur at some time and how and when that can occur. That's sort of part of the complex question. But that's sort of what I see there in terms of that question about, you know, failure of connection. ... I suppose those models of development that we currently have and how they can either constrain or enable different ways of thinking and responding.” (S105)

(ii) Reality of a consumer society impossible to break
At the same time while there was agreement alternatives needed to be encouraged there was also a framing of the drive to be competitive. In this view Australia was comparatively ‘still developing’. There was a sense of injustice here where Europe had contributed significantly to the current state of atmospheric CO₂ while the rest of the world had to share the cost of carbon reduction. This was further framed by a view of development as a bigger force than action in Australian could influence. Under current conditions of global competition Australian fossil fuel resources are a sought after commodity and renewable energy and other alternatives for Australian were not competitive enough.

“We could just go now to alternative energy, in which case our entire economy would collapse, and I don’t really want the social ramifications of that, I don’t want to be around to see that, but we have to try and work towards it. I’m not saying but yes it’s, we have a few very real issues that we have to deal with. With ideals I’d love to get to, like total renewables but it ain’t, that ain’t easy. ... You can’t just jump to it. You’ve got to push towards it, but we have a resource there that is exploitable, that if we don’t deal with it responsibly, because we have the guardianship of it, we could fritter it away. Or someone else will come and take it off us, and that is a reality.” (M006)

(iii) Anticipate things happening in the future
From another perspective research was not future oriented enough as it was configured by demand rather than foresight. In this understanding problems were framed in a way that directed how money was spent and as indicated by one of the managers interviewed funding was an important vehicle for linking projects. Here a concern was raised that there was a lack of investment directed at anticipating problems that might emerge in the course of development pathways. This view understood policy and research to be much more closely interlinked in relations of cause and effect.

“We use a lot of extrapolation. There's a lot of straight line trend forecasting. Do we do forecasting, do we do foresighting? So, I mean the mental models that say let's extrapolate the future. There's that approach and there are many others as well that we can be doing at the same time to see how they inform different ways of developing policy. So it's like, say in terms of linked up, I don't think research and policy is closely linked. They're seen as two separate domains. They need to be tightly linked together, that research and practice. So one and the same thing, it's just a different way of perceiving that at any one time. One doesn't precede the other, they both co-exist, you know, mutually dependent. And we don't have that way of understanding how we develop policy at the moment.” (S105)

(c) Recognising and rewarding feedback and collaboration

(i) Different points of view not easy to connect
There were differences in perspectives between policy makers and farmers. Concerns at the farm level sought immediate benefit while policy wanted to manage risks into the future and this represented a poor articulation of connections. One perspective reflected concerns that farmer ideas of investment risk were changing according to unanticipated consequence. Issues such as access supplies and access to water and consumer acceptance of GM raised the stakes for framers taking investment risks. Trading off the risks meant that there was a higher level of gain required to substantiate farming investments.

“I mean you just keep hearing different perspectives of it, and how do you actually put those into a framework. I mean for example we met with Murray Goulburn big Dairy Manufacture and they're talking about saying well it's a continuity of supply issue, so they're saying we need to keep milk production in Northern Victoria from going down because there's all this infrastructure and how are we going to develop new farming systems to cope with reduced water supply. Is it going to be cut and carry, is it going to be feedline? But we need to get milk supplied out of that region for the whole of the industry.” (M004)

“Another one saying so if we're going to go down the genetically modified pathway about drought tolerant pasture species. They're saying we need substantial gains for us to even think about going down that, the risk to our supply and people accepting our product is huge. So we're not talking about a 5, 10% increase in drought resistance, that's just not going to even get us to a point where we consider it, because it's potentially such a big issue. You even have to talk about sort of 30, 40, 50% gain in drought tolerance or productivity before they will even think about.” (M004)

“So you keep getting these sort of layers upon layers in terms of that, and so knowing that in terms of designing your research around developing new plants to respond to climate change. You kind of then know well that's the quantum of the change we have to get before the industry considers. So you could go and spend millions and millions of dollars on this genetically modified programme to come up with a product that the industry's not going to be prepared to take the risk.” (M004)

(ii) Need to think systemically to account for interactions
This represented the view of the need to thinking holistically about the context in which technologies are designed and then used. Some adaptation measure might increase methane which could end up with conflicting outcomes in terms of ameliorating climate change. Fundamental research questions are asked but then understanding of their consequences in the field where they are applied need to be understood. This requires a view of how farmers themselves assess the value and trade-offs of new technologies to their operations. It also requires an understanding of other fundamental aspects in any given context that reductionist research does not typically consider.

“I don’t think you separate, if you actually look at the point of impact in agriculture at the farms, and some adaptation measures might actually increase meth … and others are saying we actually could end up with some conflicting outcomes here, and we do need to, we need to think of it in a farming systems context. So I guess we would be saying that yes if you go down to the fundamental research questions, they do need to be specific, but when you draw it up and apply it at the point of impact, which is at the paddock or the farm scale then they must be integrated and they must work together, and same with the story here you can’t think about soil carbon just in isolation...‖ (M004)

If looked at as a contextually rich picture in which gases and plants and animals and human and soils and technologies all interact a different view of ‘balance sheet’ would be realised. The overemphasis on gases misses the connection to other dynamics and processes. It represents a systemic view of gases not gases-system interaction that might surface another view of complexity. Looking at trade off between carbon, water and food production is going to lead to a different picture, which reductionist thinking can find difficult to get surmount.

“....if you put heaps of carbon on, so that might give you one issue, but then that will stimulate a whole lot of nitrous oxide and productivity in methane which is three times higher in carbon than what, the combustion will get … so if you keep going down, and that’s the challenge about, you can’t think about one issue in isolation being adaptation or mitigation, or be it one component of the farming system, the animal, the soil, and even at the catchment scale, and we’re doing a lot of work in looking at the trade off between carbon, water and food production, and where are the trade offs now so, and it’s hard. Really hard to start to think about those sorts of things.” (M004)

(iii) Understanding change from farmers’ perspective

There was importance attached to some projects seen as successes where researchers and extension people have been working together and trying to understand system change from the perspective of farmers. Programs like EverGraze and Lifetime Wool were recognised as providing important means for interaction.

“Something like EverGraze I mean is pretty good. We actually have, when we start off the current round of EverGraze, we’ve specifically put extension people in beside our researchers to look at how, the question is how do you encourage people to adopt an entirely new system. So in the meat production system sense I think we’re doing that pretty well. We have farmer groups working with our researchers to understand it from their perception, from their viewpoint...” (M006)

“...we had a project called Lifetime Wool which was looking at the whole reproduction system, and that was about. The research aim was to demonstrate, or to understand how the feeding of the ewe in the last two months to three months of pregnancy, affects the lifetime productivity of the progeny. Because as the embryo is forming, that can have impact on how well you feed the ewe then, can have an impact on the lifetime production. Now it was always known, but it wasn’t known how economic it was and all that.” (M006)

In this small set of activities the success was seen in the importance of farmer participation. However their involvement was not in design but rather verification that the
tools and technologies developed were useful in context. The use of ‘proof sites’ was seen to involve ‘less intensive research’ that served as semi research and demonstration that could be developed into education programs. However it was recognised that these projects are longer, more complex processes and of less interest to investors.

“What came out of that work was an entire change in attitude to the way we feed our ewes at around the reproduction, the annual reproduction cycle. The way it become, enormous, one of the most successful projects we’ve ever run is because we had farmer participation from day one. We had farmers involved in the research, it was done on farms, it was the fully biometrically okay research done with farms, and it was then taken out, it was first of all done with two or three very intensive sites, not far from research stations.” (M006)

“In dairy it’s a little bit more fragmented, in cropping I’m not quite sure, there are some bits seem to be working, and in horticulture I’m not close enough to the industry to quite understand that. But I think that you need that involvement of your in users and your intermediate users in the research, so that they can see from day one how that would start fitting their system. To understand that it’s not a yes-no answer, there’s a lot of grey. But they can profit from it, so that to me seems to be where it’s working. We’ve just got to get better at it.” (M006)

(iii) Inviting new ways of communicating

However against this perspective was the view of science as opening too narrow a field for dialogue. This was opening up a perspective of scientists being better able to articulate their knowledge in contexts which people could relate to. In particular there was a need to communicate about the implications of science and the impacts of knowledge applied in their systems of operation. If working more closely with communities where there was a need for greater dialogue on research, and as indicated by one of the stakeholders using narrative research for better linking science in the context of daily lives.

“Scientists are not necessarily good communicators, they’re ‘municators’, they have a narrow view of what communication actually is. Quite often a lot of our people all they want to do is produce the scientific paper, don’t understand that, that tells you the quality of the science, but it’s open for review, it’s open to peer review and it says this is the quality of our work. It’s a perfectly awful way to explain to people how it will impact on their system, and so what we’re trying to do is to say there are other forms of communication that are legitimate, that are important that you need to do to try and expand that.” (M006)

(v) Little feedback received from people on the ground

There was also some discussion of scientists working with a practice change group but that they would ‘probably like to work a bit more’ with that at least to ‘understand how we might be able to communicate better’. This was another framing that led viewed the farm context as important space to realise how things interact. It promoted the view that researchers ‘can’t look at issues in isolation’ where everything so dependent on the other. From this perspective you could generate a ‘basic understanding of how crops grow and interact with the environment’ but there was also a need to understand that things will work differently in different contexts. This was a practice view science in the field as being the same across all scientific disciplines ‘understanding how things grow and interact with the environment, whether it’s people in their world … or how a crop grows’ whether its people or crops. Furthermore this view promoted that a better understanding ultimately meant ‘better control’ of agricultural systems.

“I suppose because people like me interact with farmers at the ground level, we’re really the people who hear what their concerns are, and that in theory should be fed back into the design of R&D. In practice I don’t think that cycle works very well because of the nature of the preparation for R&D projects. Researchers are reluctant, in most cases, to
do a lot of research on the needs through extension people. I don’t know how they perceive what the needs are, but they perceive what the needs are, they don’t necessarily do it through people like me. So yeah it’s a bit of brokenness about that cycle." (S010)

There was a further sense that attitudes towards farmers were often misguided where they were sophisticated in the technology they use and their understanding of markets that gave them far better understanding of context. This high degree of knowledge in the field of pragmatics was often well equipped to critique where researchers ‘can come up with an idea but it must be practical’. There was also practical value and support for working closer working with others in the department including a respect and willingness to work with others.

“I think there’s an attitude in particular the closer you get to Melbourne that farmers are peasants and that they need to be told what to do because they are just dumb and they are all going broke because they can’t handle the drought and they just sit there and mope, but I tell you the technology they use, the understanding of the marketing, the knowledge they have is quite remarkable and I think it is very much under estimated. So we need that interaction with them to understand what the issues are and whether or not what we are going is going to address that. You can come up with a great idea but if it’s completely impractical, and it’s very easy to do that....“ (M011)

“The farmers are an inspiration. GRDC, probably we don’t have a lot to do with the policy. That’s probably just because of where our projects are funded from but I think VCCAP obviously is very much a part of the policy, the stakeholders, indirectly I suppose policy makers are stakeholders as well, but it’s more the farmers, the breeders, the grains industry. Those are probably who I work with more, but we do have to obviously answer to our own project managers and all the rest of it who make the decisions of where to put funding.” (M011)

**(d) Connecting across disciplines, concepts, models, etc**

**Biophysical and social resilience not connected up**

From another external DPI perspective there were good links between biophysical scientists but poorer integration with biophysical and social sciences. This indicated that DPI, at least through some of its workshops and VCCAP activities was starting to open opportunities for integration..

“There are parts. I mean there’s nothing universal is there. There are linked up parts. There’s been some great linking up between the global climate modelling type people and water industry kind of people. But it’s always been very much: the big link between the biophysical players, I suppose if you put it that way: the biophysical researchers are linked pretty well. That’s probably because it’s a natural kind of linkage: sort of science-based and reductionist science type of thing. Like I mentioned before, you can look at history with data and what are in-flows and can relate that to climate analogues.” (S008)

“We can say this is how it was in this period and that period: everyone can talk the same sort of language more or less. But the linkage back to things like policy or some of the social resilience is where you get in to these really difficult kind of, well unlinked. So if there is 20% less water. So the climate change is probably going to mean there’s much less water, or it’s going to be more infrequent, or whatever they come up with. Then the link back into: what does that mean for communities, or what does that mean for policy? It’s not very well defined: the linkages. It tends to be a provision of information which is different to linkages.” (S008)

However it was also recognised that there was difficulty with policy and social resilience and defining what interactions between science and policy meant for communities. This reflection was reinforced by others interviewed that researchers don’t necessarily have a
good understanding of policy. On the other funding collaborative projects was seen as a means to get some integration between disciplines

“That's a perfect example of where you get researchers who don't understand how policy works, for example. They then think the researchers and it's probably got to do with their careers. One of the main things that drives research is the publication of the outcomes, so there's no, there isn't any reward for a researcher. I haven't seen it, anyway, to be joined up and integrated with other players in the spectrum of policy and the community spectrum. In fact, it usually hampers careers as far as I can see. The career development of a researcher is to publish and therefore very little of its about collaborating. Anyway, it's just a blocker.” (S008)

“So those that choose to integrate and work closely with other disciplines like policy, or government, or community: unless they can convert that into a publishing regime, they'd find it very hard, it's very hard. The other reason that linkages happen is because of investments and those ones I talked about earlier on. Because we had good arrangements with CSIRO and those sorts of players, which is actually service level agreements signed up by government, dollars exchanged and people were paid to play, basically.” (S008)

(ii) Conflicts in some perceptions and widely varying beliefs
Contrary to the view that the climate science and water science were getting well connected through a focus on local problems of supply there was a view of soil and engineering to be disparate when it came to realising the possibility for soil sequestration of carbon. It was also thought biophysical and sociocultural research remains poorly connected. On the issue of soil carbon sequestration there was widely varying beliefs from soil not being measurable over the lifespan of one person. This was seen as an issue for one stakeholder that there was no means to back up the claim of soil carbon cycling which left people confused by conflicting messages in policy debates.

“For instance we have... there’s soil carbon is a real issue and the potential for us to store carbon in the soil and therefore mitigate the greenhouse emissions into the atmosphere. There are widely varying beliefs about our ability to do that, and that ranges from the scientists right through to the highest end of politics. So we look at the Coalition’s climate change theories and the program they might put in place would rely heavily on storing carbon as soil carbon for our farms, and the researchers that I talk to, personally within DPI are saying, “We can’t even say that that is achievable”, the research says that’s not measurable, the amount of extra carbon you’re going to store in soil is not measurable over a lifespan that one person might manage that farm, those thirty years.” (S010)

(iii) Getting people from different areas working together
Emphasis was also given to getting researchers working together through different areas of interaction and in big projects. For example by working with carbon sequestration, there was potential integration into livestock systems and how they compliment each other. This view was framed as ‘getting your hands dirty’ by having that interaction to try and solve problems in different research areas that had not been worked in before. This supported a view that disciplines can contribute different skills as a positive perspective on the problem focused issues that climate change research brings.

“I think when you’ve got researchers working together they can be working in quite different areas, but just that interaction and big projects where they are being brought in together. I mean certainly I am working very closely with someone who is involved in carbon sequestration and the cropping is very important for that because they’re going from long term pastures which have got higher soil carbons, they’re being ripped up to put in the cropping, you are losing a lot of carbon, looking at different stubble management issues, so we are working very closely with the carbon sequestration.” (M011)
“Where you are in there getting your hands dirty is having that interaction with people who are actually trying to solve problems in different areas. You can know nothing about a certain area and you can go to a meeting or something like that and you can contribute to that, they can contribute to yours because they’ve got different skills and see things in different areas, so I think as researchers we very much integrate what – I would like to be a bit more – we certainly have some involvement with the extension group.” (M011)

(e) Organisational structures to support integration

(i) Get people together that otherwise wouldn’t

In the context of VCCAP there was initial planned thinking in a multi-disciplinary and cross-industry space with a view to understand the holistic impact of climate change. The program design was recognised as developing a multi-disciplinary skill set to deliberately get people talking to each other across policy makers, policy researcher, social scientists, biophysical modellers, economist, spatial planners, land use planners and scenario planners. However the experience deteriorated and people reverted to their comfort zones, which resulted in efforts to reconnect in the final year structured around meetings and workshops.

“So in actual fact ... the leader of VCCAP ha[d] to continually be pushing and cajoling these various groups to say, “You will have a workshop. You will sit down and you will talk about what the collective value is that your component and your component collectively bring, where the additional value is by bringing the biophysical together with the social or the biophysical together with the economic. And so the final year of VCAAP is very much structured around a series of meetings, workshops between these various components of the multi-disciplinary team. So actually then you find that additional collective value as a result of the cross-disciplinary nature of the work that they’re doing.” (M001)

The approach to implementing VCCAP was through a series of theme in social and biophysical research. An effort was made to tried get researchers out their separate institutional spaces or ‘silos’. This perspective saw the social space as a hindrance where researchers were unwilling to accommodate others within their systemic model. This was framed as seeing systems thinking as external application not internal reflection of how researchers saw themselves.

“We think in a social space. We don’t think in a biophysical space. So we’ll just deal with our little zone. And I suppose that’s been a little bit of a challenge because a lot of the people are involved that are people that have been talking systems thinking. But I find that what they mean by that is when I think of my system I’ll think of a system holistically but that’s my system and if you as a social scientist want to be involved you’ve got to come and join my system. I’m not going to expand my system to encompass your system. This is my system. Come and join my system. So it’s system thinking up here but not system thinking inside.” (M001)

“It’s thinking about the system as a system but not thinking that you’re actually part of that system, that you have to actually change your behaviour to operate in a systems way as well as the systems you’re looking at. So it’s personally applying the systems thinking rather than just applying it to the problem. And that I think has been the problem.” (M001)

Contrasting this perspective was a view that the capacity already existed and that it was just a matter of finding the means to facilitate connections between the divisions. This represented the view that there was a good degree of information sharing within department

“I think there is a fairly good degree of information sharing between those areas of research, education/extension and policy perspective with a number of my colleagues who
do very good work in establishing information sharing forums within the department which I think are fairly effective.” (S012)

The good work done in sharing information was supported in some contexts in establishing information sharing forums. While this view was shared by some not everyone saw the internal system of communication as working that well, which was contrary to some other views from M004, M006, M007, S010 for example.

Furthermore there was concern that the areas of policy is limited in human resources and often have timelines of hours in which they are under considerable pressure to produce information. This raised a concern of how best to educate ministers about the complexity if issues. On the other the opportunity to have a workshop between policy makers and scientists from different disciplines proved a valuable insight to how a lack of interaction can produce some failures in understanding.

“We’re finding with people like Policy they work in a here and now world, like everybody, they’re stuck for resources, and in this case it’s a people resource. Our Policy people we’ve got some very smart cookies, but they have timelines of hours, not years for which they have to produce information. They do try their best to educate our ministers and others, but hang on this does take time. But part of it’s also helping educate them. We had a workshop just two days ago on soils, and it was a new way of operating for our policy where we have the energy, the extension and agriculture extension, agriculture research arms all got together with the Policy guys and looked at soil carbon.” (M006)

“Energy are saying this is the saviour of the coal industry because we can put the carbon that we’ve captured back into the soil, which the soil holds so much carbon in the world, it’s obviously got potential. So from an engineering perspective this is a real winner. The soil scientist says it’s a load of tosh, there is no way, I don’t think his words were as nice as that, a load of crap, it don’t work because what you don’t realise is that a lot of soils can’t hold carbon. So you had engineers and soil scientists with different views.” (M006)

(ii) Linkages break down further down the organisation

Another perspective of linkages was that of conceptual integration between different research projects. From this view there were linkage at the divisional level but the further you move down the less related components became. This offers reinforcement of an earlier view that conceptual integration breaks down in implementation. It also is supported by the perspective in conversation that the strategy documents seem to frame things systemically but then it does not get realised in practice.

“... there is linkage, it could be better, but at least at a divisional level we know what we’re doing and where the connection points are. I guess the further you move down, the more less related some of the components are, but we do work very hard through the key project manager to link up a lot of the climate change research.” (M004)

Others saw value in coming together working on a project with people by trying to solve a common problem coming at it from a different perspective. From those viewpoints the new processes of research management and project inception were viewed favourably because they enabled conversations around project proposals and people from different disciplines to provide input. Sharing knowledge was also seen here as broadening the understanding of the issue. However this was contrary to other views which indicate that not everyone finds this process valuable to research design. At the same time it was acknowledge that people from other disciplines don’t know the ‘right question’s to ask.

“There are times when you come together, particularly if you are working on a project with people and I think that’s more of a formal way of doing it and that’s a very good way of doing it because you’ve all got common goals, common target and you are all trying to solve a common problem and coming at it from a different angle, so that’s a really good
way. In this institute, for example, they've introduced these pre-schedule meetings, so before you put anything in the ground you have to go through a pre-schedule where you say what your hypothesis is and what you are doing to – what measurements you are taking and all the rest of it so you know that that hypothesis is going to be met and you are going to be able to see what’s happening, and we get people from all different, animals, soils, whatever, coming to those meetings and providing input.” (M011)

(ii) Connecting up unlikely group learning
There was value recognised in getting policy people together with researchers in going through group learning process. This was seen as leading to new potential problem framing and solutions by integrating different views of the world. To some extent this was attributed to systems science that valued all perspectives as having a legitimate place in the world and facilitating as the art of getting them together to start talking and communicating.

“We had Policy people in the room and suddenly through a group work learning which they had never done before, they realised well one it's more complex, but two there are potentially solutions between these two different views of the world, and the people that held those views also realised that hang on the coal guy, the soil scientist saying now well the coal guy they, they've got a legitimate place in the world and they've got a legitimate problem, now maybe we could work towards it and vice versa. It's actually getting them together to start talking and communicating at a different level, as long as their minds are open then we're pretty right, and part of my job is to create opportunities for that to happen.” (M006)

“It's to run or to commission work in system science to enable workshops like we had in, a couple of months ago. It's about doing that, and that's part of that bigger picture of realising, getting people to realise there's a bigger context for their work, and explaining it in different ways, it's not talking down to people, it's not, the word I find completely repulsive in this context is simplifying, it's 'plainifying', I know that's a bastardisation of English, but we have got complex issues, and we have got complex concepts to convey.” (M006)

However it was clear that ‘communicating’ was not necessarily trouble free with getting people in research realise the bigger context and people ‘receiving it’ understand that as well. In reality different worldviews lead to tensions that need to be managed in the process of interaction such that personalities and perspectives can be freely aired with respect for other points of view.

(iii) Importance of building relationship from the start
One participant emphasised the important of a good project framework which can eliminate a lot of the confusion. This was in reflection of a longer process in which it was realised that a lack of planning can result in wasting of resources and competition. As a result of this experience the research manager has now changed their approach to project development to become a better facilitator in collaborative project design.

“So the whole vegetable project is a sub-centre of my overall portfolio but it's an interesting case study. I fundamentally subscribe to the hypothesis if you like that if you've got a good framework for a project, one that everybody can relate to, that has a logical pathway to the outcome, that identifies the roles of all the people within the labyrinth almost, a lot of the confusion, destructive competition and wasting of resources and stuff actually evaporates.” (M007)

(iv) Investing time in bringing work together
From another managers viewpoint the organisation were trying to get the best value for money but such a complex issue that can’t yet imagine what the whole system looks like. There is a sense of not yet having all the lines of interaction mapped with so many
interactions and feedbacks, yet an expectation that a picture might emerge that makes sense. Here there was a perceived need to bring the right people together and to revisit the work every two years as knowledge advances and understanding is advanced.

“It's linked, but I reckon we can do it better. ...I really feel as though we really haven't got the various wires of the systems analysis that deals with climate change. We really haven't got a best estimate at our appropriate level of interactions and the power and importance of various factors. We're really saying, where we are investing to get the best bang for the buck. So that's a very fuzzy, conceptual model, I guess I've got in my mind: don't ask me to map it out. We've got so many elements of it, but I don't think we've really invested the time to bring it together in the way where the issue justifies it.” (M007)

“I think getting the right people together with the right process wouldn't take a long time to do. It's the sort of thing I reckon you could probably do in a day or a couple of days. It's one of those things you'd probably need to revisit in eighteen months or two years' time, anyway because new knowledge has come to hand. If we got a group of people to do it today, it would be quite different to what it would have been drawn up a few years ago. That's because people's knowledge has advanced and their understand has advanced. So these things are a journey I reckon, they're not an event.” (M007)

“But it's part of it: that bringing that understanding together: that sharing and having a way to share it. To me, that's what the entire thing is about: the way I understand by a systems approach. Because climate change is a classic example, if we're not dealing with it in a systems context we're completely missing the point. Because there are just so many interactions and feedback points. As a revision, Future Farming Systems Research, if we're not on top of it, why not? If we're not on top of what the systems look like.” (M007)

In summary there was a rich picture created by participants in the various areas in which research was linked or poorly connected. Some thematic areas were identified however there was considerable diversity in the ways linkages were framed and what metaphors were used to explain them. Research was seen to be linked up through formal and informal networks and in the recognition of new relationships through research collaboration. However there were areas in which there was an insufficient degree of linkage, e.g. in recognising and rewarding feedback and collaboration, and with some difficulties in facilitating conceptual integration across disciplines, concepts and models. Suggested areas for change included some aspects of organisational structure in getting people aligned that would otherwise not interact, addressing the breakdown in conceptual integration once projects are implemented and investing time in brining different stakeholders and disciplines together in collaborative work.

4.3.5 Areas of emphasis

Table 4.11 Emphasised aspects

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Additional comment was invited through an open-ended question at the end of each interview. This provided an opportunity to add or emphasise aspects that participants thought were important. Table 4.11 summarises responses as a set of themes. Suggestions included breaking conceptual barriers to integration, creating opportunity for doing things differently and being explicit about the historical awareness of the CCA.
situation. Participants also recognised additional value in taking a step back from issues to improve perspective and in overcoming barriers to building adaptive capacity.

(i) Breaking institutional barriers to integration

One view indicated that senior managers and directors want cross-cutting work but those operating in middle management had the tendency to want to break projects up into silos. From this perspective management protocols were a strong driver of administrative processes rather than providing opportunities to for more open ended discussions and collaborations. The indication was that two messages are going out on the view of collaborative approaches where on the one hand they are spoken of positively but on the other there is difficulty realising their value.

“It's easier to manage things in silos. You've got some neat little boundary around what you manage. It's easier to manage. And so you're going to keep running into this block in the middle of the middle managers who are not paid to be systems thinkers. They're paid to manage and tick boxes.” (M001)

“And if they are to respond to a more cross-industry, cross-divisional approach it's a real challenge for them because it's much harder to tick boxes in there. But it's far more rewarding but it's, you move far further forward in a shorter space of time. But for them to manage that is far harder.” (M001)

“...my observation is when people get it, they really get it. But when people don't, I don't know whether getting them in the tent on a thinking frame. I think they've, if I went to [senior manager] I don't know whether he’s, I don't think he gets it, and I don't think he sees the value in it, and that’s a fundamental problem for me, even though we’ve had workshops and whatever.” (M004)

Yet there were other more positive views of working project funding through much better processes, e.g., by having an investment conference and enabling research project development that better fits the goals at the directorate level. Arguably one of the problems then is the autonomy in the middle layer over how funds are distributed which runs contrary to the areas perceived from the ground and at the upper level of management.

“...if you want social research and practice change research in a future program [you] have to find the half a million dollars from an external source, send it to this group... And yet the rhetoric we get from the top is we want multi-disciplinary, cross-industry, cross-divisional projects. But the structure they put in place is directly opposed to that.” (M001)

In addition to this view there was a desire expressed for keeping external funding for collaborative work out of the projects assessment groups where there was a fear of integrated work being broken up into silos of divisional interests. Furthermore there were other example of how funding connected to broader research networks facilitated a more open process of stakeholder engagement with research, such as the EverGraze and Greenhouse in Agriculture programs.

“I think that we’ve got to learn to blend our, there is a … not everything is systems science, and systems thinking and not everything is solved by reductionist thinking. We have to blend the two together, that’s the key and I think it’s very much manifest in the climate change space because we are playing with systems, and so we've got to be able to use the reductionist approach to solve those problems, but then we’ve got to place it in the system and I think this is where it comes together more than we’ve had happen in the past, and so we’re forced to go down this path.” (M006)

“There'll be, from my perspective, scientists that are absolutely appalling at systems thinking and no matter how much, how hard they try they just won't get the hang of it,
that's fine. Lets, but lets make sure we don't, that we express their work and put them in a
place where we can get the maximum from them, and vice versa because sometimes it
just seems the approach doesn't always solve a problem that does require getting into the
minutiae." (M006)

The blending of systemic and reductionist approaches is an interest for those working
within the organisation. This was realised in observations as mapping a middle ground
where you can get support not just in modelling but in robust validation of systems
approaches. However there is another dimension of this issue where it is recognised that
there are going to be some people within the organisation that will not embrace the
approach. This limits how DPI can build on the existing and developed capability to add
value to the way DPI organises thinking about systems.

“I just feel that there’s being able to put together layers of systems around what's going on
and how they work is a fairly strategic thing and the challenge is for us not to frighten the
horses and not to get bogged down in it. Because ultimately, it's a means to an end, it's
not the end. It's a means of us understanding how all the work fits together and how it
could find and contributes to the outcomes that we're after and helping understand those
interactions and feedbacks.” (M007)

“I think that's they would have to be involved in it. I think they have to do it. The issue is
about dealing with it in a reasonable time frame so they don’t get bored and bugger off.
But if they do, it's going to be more powerful, rather than if it's done for them. It'll just be
more powerful and experiential. ... It can become more of the norm, in terms of mode of
operation.” (M007)

From one perspective there was value in forcing people to work together as a mean to
focus on a particular problem for solution, which is not going to be facilitated without
support. ON the other hand this view supported an overall perspective of sharing data on
project framing but not getting closer than that to actually learn something substantive
from thee experience, as earlier noted, leading to some tangible change in the way
decision and actions were taken.

“I suppose the best way to do that would be to have people forced together in a project-
centred – people from a whole lot of different places and try to come up with solutions.
That would be a – it's just not going to happen, people wandering in and saying, “I met this
engineer at this party” and I think, “Well that's not going to happen I don't think.”” (S012)

“VCCAP itself, I haven't had anything really to do with that except for the fact that we've
got this common – they are using our data and we are using the climate change
predictions to help understand where things might go for us. So in that respect it's been
pretty close, but as far as their overall VCCAP, I've probably not had a really good
understanding. That was more policy, their stakeholders and we probably don't work in
that same space.” (S012)

(ii) Opportunity for doing things differently

There was a sense that climate change creates this opportunity and that may not
necessarily continue the cycle of attention, especially of funding, if it falls off the political
agenda. At the same time it provides conditions for innovation and real opportunities for
change. A second aspect of this area concerned the need more for guidance from people
that have issues related to climate change they want to solve. There is always going to
be some risks in getting them together to find common ground but to ensure relevance
there is a desire to let ‘policy makers’ and ‘communities’ drive the research questions.
There is an expectation for Victorian agriculture to increase in value as climate change is
realised and that it's just going to be done differently.
Some reflected on the circumstance where those in government really don’t get an appreciation of how things interact at the property level open question about the systemic effects of policy. Another participant took the opportunity to use this question as a means for reflecting on systems thinking and how it had been taken up by the organisation. While there were strong interests from outside of the organisation, from this internal perspective communicating and getting the message out about systems was not so effective. From this perspective some people get lost in the detail and don’t see the practical value in systems approaches.

"...there’s a challenge there in terms of how it’s communicated and I think it’s the more recent workshop that we had. Some of it you could see 100% engaged, but then probably 50% of it is a bit out there for these people, and you lose them. So it does need to be grounded in examples and how it works with DPI and I think the practical examples and tools and how it might be. I mean the last workshop that we’ve had was using the dairy example and seeing how you could work through that, but that’s a really good way to do it, because people can see that. Whereas using another example that’s a bit more out there, it gets lost." (M004)

"...so it’s not for everyone, and, but for it to be success, some people have to get it, and how do we get those people sufficiently across it, and an understanding about how many and who and what, and what next because we need to be thinking about the next strategy...‖ (M004)

Climate change was seen as a driver for programs and research but that the results of inquiry could not be expected to produce the technical solutions. This reinforces the concern that climate change will go off the agenda and capability built in systems will lose a problem for its application. However there was interest from other areas of government that indicated more support for linking up DPI research activities to other areas of government.

"I suppose at the moment we’re at a point where climate change research, in terms of mitigation of greenhouse gas emissions, hasn’t produced any silver bullets. So we talk about things that might be possible in the future, like dietary changes or something like that, but they’re in the future, and on the other hand we’re saying, we need to act now.‖ (S010)

"So luckily, fortuitously a lot of the farm management practices that are associated with reduced greenhouse gas emissions are our current best practice farming systems which we would advocate anyway for other reasons, being efficiency, productivity, profitability, that sort of stuff, so the need to make sure that your animals are growing as fast as they can so you can turn them off quicker, that translates into less greenhouse gas emissions." (S010)

"We are probably, as I said, focussed on our own little area and it would be good if there was some sort of mechanism to go really across not just industries within agriculture, but to go completely through even our primary industries, but some of the other areas, engineering, all these other, energy and that sort of thing. I am sure if we had more exposure and there were more links there that that would completely open up eyes to what would be possible." (M011)

(iii) Being explicit on historical awareness

Having a historical awareness of connection to traditions of social and political circumstances was also necessary to visualise change. For example, the issue of international competitiveness and the sense of natural justice or ownership of resources like water was a historically embedded and conditioned view of the situation. However, to move out from the historical basis of rationalised action may fail because of a misreading of the environment. From one perspective there was a need seen to be learning from the
evidence to give strength to the challenge of prior assumptions that were culturally embedded. However another view was of taking a different approach to science for enabling foresight on possible futures with some means of realising relationships in the present that will serve better or worse trajectories of adaptation.

However the dominant discourse around improved productivity through technological innovation was framing the main trajectory for research investment. There was a recognised limit to the possibility of endless improvement where the real boundaries to the existing system of production would be realised. However it was important that farmers existing income streams were not too far perturbed to enable their gradual transformation to accommodate new risks.

“...with the possible exception of wool, all of our other agricultural industries have learnt this magic trick of farming a smaller area of land done by less people, but producing more. I see there’s this wonderful conjuring trick, that we’re able to do less with more, and on an on-going basis.” (S002)

“...a lot of it has been ... synthetic fertilisers, use of significant mechanisation of farms are replacing labour with mechanisation, and more recently it’s also changing, improved, more breeding and husbandry practices and improved crops. Drought tolerant crops, all this sort of thing, so I suppose we’re constantly trying to push the boundaries of our production systems out so you continually seek to improve them. How long do we keep doing that, who’s to say.” (S002)

For one manager there was a need to step in with public support, as is claimed when there is a market failure, to invest in building initial capability and to seed ideas into further research or practice. However research relationships can over determine actions where, for example, a regulatory response is provided for market problem or visa versa. The question arises here of how often historical conditions are considered and how well understood the current situation is on past cultures and values.

“I really think it’s the role of government to invest in things like climate change research where a long way into the future they’ve got a potentially massive social and economic repercussion. And I think we should throw out the window as a sort of rough rule of thumb, that if you don’t get co-investment you don’t continue to get it. Now, if you say this to people, to do the investing, they’ll deny it; but I just know that that’s just the way it is and you’re expected to find some co-investment.” (M003)

“Except that I've talked about the adaptive stuff: the continuous learning loop from that. The fact of feedback of things and learning out again: I suppose this thing for me has got to have a formalised loop of communication. There needs to be a formalised review phase: put the brakes on for a bit and have a little bit of a look and see what's been going on instead of wandering through time and adaptive management should happen. I think you really need time to sit back and reflect on the value that’s been added and researchers need to do that as well. So that needs to be resourced which is a real issue I reckon.” (S008)

(iv) Taking a step back to improve perspective

As it currently stood there were fragmented opportunities and foreseeing the effects of environmental change was limited by the integration of a whole perspective of interactions between biophysical and social systems. Being able to better 'read' the dependencies and opportunities for better predictive capacity in areas of uncertainty meant taking a step back from processes. Part of this means pre-empting the effects of acting under conditions of uncertainty. It also provides an opportunity for realising efficiencies in research by understanding adoption capacity which requires working with
end users in the broader sense to determine the value of research to decisions and actions taken.

At the same time enabling a vertical and horizontal perspective for filling the structural void was an important part of enabling markets and community responses. Such capacity that takes a different view to tackling the problem of change might better see what are the various pathways, exits pathways, future pathways for CCA.

“I think there’s a lot of positive things, I think to all pull together in one portfolio is good and I think people – between you and I - a bad thing perhaps, but it was just another pragmatic decision - that a lot of the projects initially, because it had so much money and we’ve still got the biggest amount of potential research funds to invest, there’s a lot of projects rolled into it, we just re-badge them - they weren’t really - they weren’t going to get funded and lots of people lost their – they weren’t going to be reemployed.” (M003)

“Things are just rolling, so the research is doing the adaptation as well. It’s not kind of being smart, if you like. It’s just rolling: a knee jerk. Anything else I can tell you that we didn’t have climate change adaptation to research in Victoria. That award on the board from 2003: that wasn’t for me, but it was the first for that year: probably 2002-2003. in Victoria, there was nothing until then: no government investment.” (S008)

“...it's just been a rolling snowball. You've got to watch that because it an adaptive thing, but it's just as much inside the maelstrom and just as much a social construct as everything else is. So they need to be resourced to spend some time thinking back on what we were just doing instead of sitting back and looking at what are we really doing here. Is this added value? Is this making a difference? What are some of the perceived needs? We've missed something. ... And to spend the time shaping the research, to spend the time shaping the questions.” (S008)

There are different perspectives of this depending on whether there’s concern about getting greater government investment to drive the processes of change. However on the other there’s the need for government to step back from its own activities to be able to measure its performance and efficacy on the ground. It connects up to government investment ultimately and how it can be better directed or more responsive to driving change.

There was one comment offering a different view from those who see the problem in the distribution of funds in the middle layers of management. It proposed that the organisation itself prevents certain opportunities from developing. There is a degree of competitive autonomy that acts culturally to prevent people from linking up. Furthermore there is little incentive for collaboration or for working across areas of government.

“We could do a lot more if we had a bigger view of the world than just focussing on our own little area which, as I said, we do quite well across industries because of the people. Everyone gets on very well and they are very open, but it would be good to take that further, but it’s getting the time and still managing to get your head around all the other issues and still deliver on your specific tight project deliverables and we struggle with that because we don’t have staff” (S011)

“I mean everyone workload is just getting greater and greater so you don’t have the space to think more laterally outside of your little area and I think something like climate change because it’s just so huge and affects everything, then I think it is a really good opportunity to look at your own little world through different eyes.” (S011)

(v) Overcoming barriers to building adaptive capacity

People still in a state of denial or ambivalence and caught up in the everyday presented barriers to government trying to broker projects with them. There was a need to see CCA
research as a shared journey. Comprehending the immediate and the longer term requires some bold thinking. People were focused on the issue of the day there’s a need to be able to work in with their thinking and at the same time not let the issue go off the agenda. Giving stakeholders the confidence for making investment decisions that reap benefits further out into the future may mean the need to build in multiple time frames for outcomes.

Such confidence was building incrementally, getting people to the stage of being able to cope with ‘big’ change by supporting resilience to shocks and getting smarter at controlling costs. Overcoming barriers to adaptive capacity was linked to taking a step back and being able to see where change needed in the partway move towards the more dramatic transformation with less dependency on fossil fuels and greater versatility in farming lifestyles. It is getting people into a position where the more dramatic transformation is made easier.

There was some anxiety about keeping the flow of money through to a new program of research. Others suggested a closer examination of funding and recognising that incentives are needed for industry to really drive the process of change. This added weight to the view that there was too much denial about climate change for getting the support of industry. However in reality research managers were managing a workforce which is rationalised against goals and policy agendas against particular areas of expertise.

“...and so you’ve got to make those decisions and if it isn’t in the budget so you’ve got to find the money somewhere. But I think we’re trying pretty hard to pull it together and do it in a reasonably systematic way but I think we’ve got a fair way to go ... one way to do it is to workshop the existing sort of project areas, the subprojects and the key projects, the larger projects, maybe in a similar fashion. Maybe we should do it first on an industry basis and mark out, “Well, what are we doing in this industry for climate change? What are the key bits that you have to work on?” And for each industry, “What are the key bits that are working in?”, and if there’s any synergies between them, what are the bits that are missing?...” (M003)

“I suppose at the moment we’re at a point where climate change research, in terms of mitigation of greenhouse gas emissions, hasn’t produced any silver bullets. So we talk about things that might be possible in the future, like dietary changes or something like that, but they’re in the future, and on the other hand we’re saying, we need to act now. If we’re going to reduce greenhouse gas emissions we’ve got to do it now. So luckily, fortuitously, a lot of the farm management practices that are associated with reduced greenhouse gas emissions are our current best practice farming systems which we would advocate anyway for other reasons, being efficiency, productivity, profitability, that sort of stuff, so the need to make sure that your animals are growing as fast as they can so you can turn them off quicker, that translates into less greenhouse gas emissions.” (S010)

(vi) Model validation against evidence of change

There were some concerns about the validity of modelling where ‘systems’ seen as somewhat spurious in its outcomes based on expectations of some future that is difficult to realise in practice. However this reflects a failure to see models as abstractions reality to be tested for accuracy against what actually happens. They are built through particular framings with the effect of reducing reality to that abstracted configuration. However the only means of testing is through experimental processes which requires a solid base of monitoring an evaluation to confirm whether models do in fact captures the most important elements of the ‘systems’ they describe.

“The need to ensure that your pastures are of the highest quality that they can be translates into less greenhouse gas emissions but also translates to more profitability of
the farming system. So there’s some good messages about... they’re not very sexy but they’re good messages about current best practice being also good for climate change mitigation." (S010)

“So that’s a big one at the moment that we need to push, but if that’s not an incentive for them to do it, and in some cases it isn’t, if that’s not an incentive then we’re kind of up against the wall because we don’t have, at the moment, another incentive that’s driven by an ETS, like that’s all on hold and that seems to have gone off the boil.” (S010)

“Before Christmas it was like; page one, two, three, four and five of the paper there was something about climate change, we’ve lost interest haven’t we, it’s now about house work or some other issue has taken over people’s mind, and even Kevin Rudd’s mind. He’s talking about things other than climate change at the moment, so I reckon that’s an issue too, and that’s about politics I reckon.” (S010)

On the other hand there is a perspective that some of the good things are already being done, in this sense, giving recognition to where changes are moving positively towards greater resilience. The realisation that this is working seems important against the possibility that much needed change may not be driven by policy, as had shown to be the case with emission trading. Despite the view that science acts independently of politics there are clearly coupled relations between the political choices and direction of research. Working against this fluctuating political science there are farmers transforming their systems for more reasons than climate change.

“if you talk to farmers out there at the moment they’ll readily acknowledge that climate change stuff has gone off the boil. All last year we were facing this spectre of agriculture being included in the CPRS and that was pretty frightening, but also engaging, because it was frightening because there were financial penalties attached, and that makes you listen, but then finally when that whole negotiation with Turnbull and all that happened, and agriculture was dropped from the CPRS, that was the stage one of backing off on whether we should ruin the engagement or not. “ (S010)

“Stage two was the perceived failure of Copenhagen talks to come up with anything concrete. So the perception is that “if no one else can be bothered, why should I? And if it’s not having an impact financially on the farm I can’t see much reason to change”, and if I just go back to what I said before about current best practice...” (S010)

“there are a lot of farmers out there who’re going to adopt current best practice because for a variety of reasons but a lot of them are associated, I believe with where they’re at in their stage of life, and if they’re comfortable; like you need a driver to change, you need a need to change, if they don’t have a need to change, and look at the average age of our farmers is sort of mid fifties, potentially they’re looking at retiring within ten years and they’re also physically and mentally at the stage of life where they’re quite happy to coast a bit...” (S010)

Modelling also provided a vehicle for collaboration and understanding of developing technology, e.g., for people to share concerns and consider ways in which change can be realised. In one example another area of government had a desire to work together with CCA researchers, integrating various fields of research to support policy development. This represented a wider range of knowledge need than DPI is currently serving and represents a broader view of stakeholding in Victorian agriculture.

“...we need the modellers and even though I insist that we need the modelling, we’ve got to have something to base our decisions on where we’re going. I still think the modelling is really airy fairy. You can’t validate the model so you just don’t know. You can do it historically, perhaps, I don’t know. But to me, when you develop a model, you’ve got to be able to robustly validate it but, of course, in this instance, you can’t because you’re dealing with something that hasn’t happened and you’re imprinting it on things that have happened so it could be completely off the track.” (M003)
“I think that one of the things that we would value is the continuation of the relationships because that's what we're very hungry for. And I guess that one of our goals at the moment is to try to start influencing and embedding research into our work.” (S005)

“...the other way around is research that say you're doing can actually highlight areas that might make these sort of not completely DPI focus, for example. There might be aspects that relate to us and to many others. And I think that would be very valuable and helpful because then it starts giving credibility and it extends our area from which we can harvest from.” (S005)

“And linked to the network and the relationships and things like that. From external sources, great ideas for ERC funding proposals may arise. And we can use ideas from outside to frame proposals from here that have a high degree of success in terms of receiving funding from cabinet. So through five year programs and things like that. And recognising that funding sources don't just simply come from government. There's, you know, all these people out here with brilliant ideas, let's bring them into the structures of government as well.” (S005)

Building closer relationship with other areas of government was viewed as important by the external DPI stakeholders. However there are as yet no formal incentives for departments to link up here. In practice it's up to the initiative and networks of people in government to make the necessary connection and influence cross-departmental research collaboration and funding. A similar issue exists within the divisions of DPI. This research itself was seen as valuable for making connections that could lead to new forms of collaboration and networks. However this contradicted the position and concern of DPI over the ‘investment’ in systems training as it was leading too far out from the organisational boundary where its benefits were intended.

Systems are seen as a tool or technique to apply just like other scientific methods rather than a basis for reflection, let alone reflexivity, which is one of the strengths of systems thinking. By working across disciplines systems thinking provides the opportunity for a more open ended critical view of research design than that constrained by disciplinary theories and methods. In this sense it is important to get people involved in these processes to really affect them profoundly and get them to open up to experiment.

These aspects provide an important reference for defining opportunities for change in the practice and management of CCA research. They also offer an appreciation of what might be desirable and culturally feasible in terms of developing a systemic framework for CCA research theory and praxis from the perspectives of people involved in CCA research.

### 4.4 Themes emerging through conversation and participant observation

Observations are a useful means of identifying recurring events, including how they are managed and for providing a narrative that describes them as a reflection of the traditional and emergent practices of research. This understanding is necessary to facilitate an open and frank discussion in the routine activities of research management practitioners and research stakeholders. Participation in the workplace culture of DPI enabled an exploration of how observations supported or contradicted the findings from interviews and documents. Most of the observations obtained in this study were through informal conversations that arose in the time of participation at DPI Parkville offices. Some conversations were held with DPI staff in other public venues.
4.4.1 Policy legitimacy

The workplace environment was convivial and socially supportive with a flowthrough of people in fulltime and part time roles and many visitors from other parts of the department for meetings and accommodated in temporary desk space. However it was clear that the organisation was strongly hierarchical with the authority from funding sources mainly located at the apex of the Department Secretary. It was also clear from early on in the experience of participation there was pressures upon researchers to provide policy advice in a short sharp delivery condensed to three second ‘elevator speech’. Such a view of research ‘value’ and influence provided little time to explain or share an understanding of research assumptions and conditions of findings. However this illustrated the important contribution that research played in providing a ‘language’ in terms of useable one sentence statements or numeric for policy discourse in which ‘facts’ could be articulated within a particular policy agenda. This was a discursive practice in which policy acted in conjunction with the unequivocal facts that scientific knowledge could provide to support policy decisions. This awareness was played out by the reference made by one of the participants to providing ‘that one sentence to put into a policy brief’. It is notable that the practice of short sharp delivery contributed to framings of research to drive a particular process of policy legitimation. Some examples of this included the desire for ‘no regrets’ options to invite action on climate from non believers and where ‘pathways to utilisation’ was framing the way research was communicated.

Observations also indicated a struggle for those in government towards providing policy and scientific advice to more open-ended decision processes. The struggle in supporting open-ended processes was against a wider discourse emerging within various areas of government to have greater engagement and participation in climate change policy and adaptation. Greater engagement means that decisions are open to negotiation and greater contingency in determining appropriate adaptation action. The discourse of engagement with communities on climate change experienced in other areas of government was less prevalent in the encounters in the DPI research community. As has been demonstrated by another study in an earlier manifestation of DNRE the organisation is strongly configured by a positivist view of science where “rational modes of thinking, a belief in objective knowledge and an absolute truth as well as the logic of optimal choice have dominated the policy process” (Boxelaar et al 2006, p. 113). Climate change and its associated uncertainties present a problem in which this type of optimisation of decision making is not possible. Alternatively to scientific policy advice as facts there was a view of creating conversational spaces to find new connections for research inquiry that were not expected to find solutions but to deliver improvements to what was agreed to be a undesirable situation. This was reinforced by the introduction of a narratives discourse for policy development in one of the external interviews. However the approach was also supported by the view of one internal stakeholder in creating the conditions for new relationships between stakeholders to emerge. Some managers’ comments supported this view to provide a fresh approach as not departing from science but recognising the value of open ended discussions to surface the limits of knowledge and new approaches for research in the area of climate change. Such an approach was more likely to produce innovations in response to climate change that moved beyond the preconceptions of past problem/solution framing.

There was another dimension of authority through which difference ways of engaging with stakeholders gave legitimacy to research questions with policy, regional or farming environments. In conversation about research and research management practice it was offered that the documents guiding research made the right framing but the organisation can’t seem to put this into practice. Although this perspective maintained and insisted a positive view of the organisation, the space for this criticism was seemingly unavailable. For people working at the interface with other researchers or as co-researcher with potential users of knowledge the capacity for internal critique or feedback was limited.
This was not the only example. There was evidence that people were disciplined through performance measures and other mechanisms to reserve a critical voice of the way the organisation was structured, reinforcing a set of loyalties to the body. It could be argued that there is an internal control over communication that limits constructive feedback were the language and the linkages in documents are enabling but then in practice researchers can’t comment on the limitations of their performance in realising the documents goals. The self discipline of researchers in providing short, sharp comments that would make it through to research directors and beyond to key stakeholders was a further illustration of control over communication practice.

4.4.2 Conceptual integration

The experience differed in another area of communication in which new ways of framing research through ‘collaboration’ were witnessed. Within the communicative spaces of DPI research management in large multidisciplinary projects, like the VCCAP work, different kinds of connection were realised. There were mixed results in the efforts to get researchers working in the same research application and integrating activities to support a particular problem focus. Conversations with people involved in VCCAP indicated that there was difficulty in getting the researchers to come together and work collaboratively. The tendency, as was described by one of the participants, was for people to fall back into their ‘silos’ or ‘comfort zones’ of research practice, after having a workshop or some other form of engagement. There was also some indication that researchers were actually reluctant to cooperate with others, although there was at least one account offered in conversation of a more successful effort in collegial collaboration. In this case a space for collaboration in recruiting expertise in regional economics had opened up in discussion and resources had been exchanged strengthening their relationship. Furthermore there was little evidence of direct hostility although there may have been some cultural constraints in autonomous research collaboration and a degree of scepticism typical of scientific professions that prevented the emergence of internal collaboration. However from another perspective there was confidence in the ways such collaborative projects were initiated, getting the conceptual integration with everyone ‘on the same page’ and then when implemented realise that all were thinking differently and retreated back to their ‘comfort zones’ in knowledge production. This perspective was also realised in experience with a set of subprojects in VCCAP, some of which were using different systems approaches to support their development. However, when attempted, the task of integrating the projects after they had been completed was difficult.

The separate parts of VCCAP splintered off into a set of sub-components, some using various aspects of systems approaches, yet there was no overarching systemic design principles used to bring all the components together. The work of conceptual integration across these parts presented a hurdle that was not pulled together until the stage of documenting the research into a final report. This was not viewed very favourably by those involved in this process and the series of ‘meetings and workshops’ in the last year of the project did not necessarily provide sufficient linkages to recognise how the parts ‘fitted together’. Indeed that task was largely seen as administrative with the person responsible to do this work appointed with limited direct experience with the three year process. The VCCAP case was illustrative of the difficult experience of conceptual integration described as ‘like pulling teeth’. Bringing multidisciplinary projects into conceptual alignment is not a straightforward process given the different ways of conceptualising problems for research and methods for their analysis across different disciplines. In such processes there is a need for specific opportunities for interaction and to breakdown differences at least to understand what assumptions and framings are shaping the work of collaborators and other research. As noted by one of the interviewees in relations to another large collaborative project, ‘some poor bugger’ has to try and integrate subcomponents into one report at the end of the project. The experience
with VCCAP indicates that the meeting and workshops in the final year were not necessarily sufficient for this task.

On the other hand there were management restrictions which placed a tighter reign on what researchers could express in their reports and findings. As was expressed by one of the researcher manager’s part of their job was to ensure that research was aligned with the organisation’s strategic goals. However the issue that people fall back into their comfort zones was expressed from various management perspectives. It was also recognised that people were less encouraged to step out and operate in a more creative research environment, as they were forced into tighter timelines and project cycles which restricted the degree of innovation they could provide. On the other hand there were some cracks in this architecture made in positive accounts of interdisciplinary engagement that arose from specific climate change problems such as carbon sequestration. The investment conference process, formalised as a way of linking researchers to the organisational goals, was also viewed favourably as an opportunity to learn what others were doing within the organisation. However when I raised the question of other processes for staff to become aware of each others work-in-progress during a staff meeting it was quickly rebuked by one of the research managers as irrelevant. In the time observations were made there were brainstorming exercises that occurred amongst research team members but little opportunity to brainstorm across different teams. In one encounter where such a meeting was purposefully organised the exercise seemed to get usurped by managerial disciplining for proposing recommendations in an area that was the responsibility of another division in the organisation. Although one of the research managers had indicated that initiation workshops had opened up thinking, it seems that there were no ongoing opportunities to open up thinking throughout the development of projects, as their evolution took them in new directions.

4.5 Summary of findings
This chapter has brought the surface some of the different ways of framing CCA research in the discourses from the wider research context at international, national and state levels; DPI strategic documents; and first hand perspective of research managers and stakeholders in research. It has raised a set of differences in discourses and themes that considered the drivers, constraints and competencies sought in research and policy development against participants views of various aspects of CCA research practice. It has sought both descriptive and reflective accounts of participant’s perspectives of CCA research surfacing different dimensions of understanding CCA research and management practice through threats posed, research concepts, stakeholder values and research connectivity. Participants’ different perspectives have been illustrated by different ways of framing CCA and use of metaphors to describe the situation. This detail and analysis is used to support the discussion following in Chapter 5 that responds to the three questions posed at the outset of systemic inquiry.

4.5.1 Threats posed by climate change
Research managers experience pressure to have to anticipate the policy context prior to issues emerging, so as to be able to bring a wider perspective to bear, in preparation for the emergent issues. In particular concern was raised about ‘acting in a planned way’ against the view that people were adapting ‘when they had no choice’. This raises the question of how to deal with food production in relation to the problem in a wider social and political context of risk and opportunity. The contrasting effects of emissions trading and its associated impacts on the costs of food production are illustrative of the dynamic. Against the uncertainty there was concern about being in step with farmers on the ground to direct policy in a way that can facilitate adaptation. However this view was further
contrasted with the anxiety of a ‘knee jerk’ policy response which responded to crisis climatic events rather than creating an anticipatory policy context in which a longer term capacity for adaptation was invested in.

This reflection is merely indicatory in scope of ways in which CCA research is being realised as ‘not being left behind’, finding the ‘front foot with farmers’ and ‘contributing to innovative practices’. Furthermore it suggests the importance of realising innovation by sustaining mental health and businesses and by engaging in issue identification and improvement. Significant threats exist in connecting climate risk with a range of factors in other areas of government such as planning and mental health. This would suggest that a space is needed, if it does not already exist, for reflection on how research is currently being framed and how better relationships might be built between different areas of government for the ‘system of CC inquiry’ that DPI manages.

4.5.2 Research making a difference
There were other areas in which views aggregated on themes such as changing the business structure but diverged in discourses on what should be done. In one example the need to change the business structure and to re-adjust how agriculture is financed to enable sustainable business into the future was cautioned against as the view of sustaining business into a future which was different from the past may not work. On the other hand there was difficulty in getting people to feel connected to the issues that were fed by the approach to reduce emissions and bring down greenhouse gases. Some concerns were about the ability of scientists to communicate about research and generating an understanding of science in general. However, there was also concern that too much focus was on industry while in reality farmers and their associated interests may lead to choices which are not right for those industries. On these aspects there was a perceived risk that government gets captured by industry to the detriment of realising the real sites of adaptation successes.

Against this view was optimism that visualisation techniques could in future connect people in different ways. However evidence was found that projected investments in communication do not always happen in practice. There are opportunities within policy circles and the community to drive the research questions and from this viewpoint research projects were not focused as well as they could be. There was agreement that policy and community could help drive some of the research questions and, if conducted appropriately, which could address some of the grieving for what had been lost as a friendly agricultural operating environment. This was also put forward by a concern that the best sites to witness things working in totality was at the farm level where different policies intersect with otherwise unknown effects. From this perspective there was a view that farmers, as key stakeholders, prefer that government come to them as joined-up rather than coming at things from a fragmentary policy focus.

4.5.3 Barriers to making a difference
Concern about the distance between research and everyday life was the expression of a desire by researchers to have closer contact with stakeholders to find out whether and how research had improved something that they did or otherwise find out how they might put research to good use ‘so that they know what you can offer’. Others framed this as ‘understand the target market’ from the outset of research design, while others believed that people who were ‘innovators’ were not part of the ‘traditional networks’ of DPI. There was also a sense of realising a diversity of research needs where not all of DPI’s stakeholders have the same perspective of research requiring a ‘better understanding of all the implications and opportunities’. Diversity was spoken of in a number of ways
including talk about ‘next and end users’ as well as ‘a variety of different routes to market’.

Raising community awareness was an apparent concern including that a number of debates on climate made it difficult to sort truth from distortion. Some expressed concern that people don’t know how to act as well as a broader concern about the relative importance of agriculture to the majority of Victorian. However some of the blame for a lack of community awareness was targeted at the scientific community being poor communicators and suggested that they have to be more imaginative in the way they talk about their research. For another the reality of situation with agriculture was seen recently in ‘a big scare with food security’ where we ‘didn’t have the wheat supply for more than 30 days’. It was important for research managers for researcher to ‘put the words in a broader context’ and ‘being able to communicate at a different level’ to achieve a wider access over the ‘pathway to utilisation’ of research findings.

Psychological barriers and denial presented some of the difficulties in opening up a conversation with key stakeholders. There was a perceived need to create a personal sense of experience to start to get that change in attitude. From this perspective ‘language is a barrier’ where people in the field were resisting the definitions and prediction of climate scientist. At the same time the media was seen to contribute to the issue of being bombarded with opinions from a variety of sources meant that ‘credible ones get as much space and the incredible ones’. Project funding and management was also seen as a barrier where there was a lack of initial investment money and inadequate means for creating a space for innovation to occur. This was seen as a risk to the longer term survival of agriculture against the unknowns of climate change. In another representation there were issues of capability and workforce planning as well as a lack of integration across divisions.

4.5.4 Stakeholders valuing of research conceptualisations

In many respects participants offered a set of frames of how research is not valued underlying concern that continued support for research in the area is more difficult to attain. This was particularly illustrated by one comment that those that are picking up interest in climate change impacts and adaptation are not part of the traditional networks. At the same time valuing depends on perspective and there were a number of lines through which this was realised. There were differences noted in people’s belief system and what impact research has on their decision making. It was also seen as valued accounting to what contribution it makes to production efficiencies or other immediate or short term benefits on their farm and business operations. Furthermore value for different conceptualisation depended on the variable geopolitical contexts.

It was clear from the range of perspectives that CCA research was not seen in the same way and therefore valued differently by different stakeholders. There was an indication that sharing a vision for CCA research cannot be assumed. This would suggest there was a need to facilitate processes in which vision can be shared through surfacing differences in perspectives and finding the ground through which they can be reconciled.

4.5.5 Further thematic development

The findings in the chapter are expressed to consider how does what people say they do reflect strategy documents. In addition it has provided a basis for exploration of three aspects of document drivers, constraints and competencies against four elements of knowledge needs, conceptual models, valuing research and research linkages expressed
in interviews. These themes are further developed into an analytical framework in Appendix 10.8.

This analysis has been framed by the rhetoric of a whole of government response to climate change. It was recognised that climate change adaptation will require the coordination and cooperation of wide ranging interests and research activities to comprehensively understand the impacts of climate change and take timely and appropriate action in realising a low carbon economy and society. It has used a nested hierarchy analysis of policy documents locating discourses of global responsibility, sustainability of development, and securing economic and resource futures. Three key framings outlined by the policy responses to these discourse were found in DPI's two strategy documents. Security of the economic and resource base of Victoria is the dominant framing for CCA research at the state level. However the strategies that have been put into operation are essentially limited to on-farm actions. Drivers are thought to be increasing farming complexity.

Future farming systems are framed as driven by maintaining productivity through technological innovation. However a new era of farming is also configured by international competitiveness, development pressures and changing values. The future challenges are within an environment of growing uncertainty of market demand, financial uncertainty and climate extremes (at the time prolonged drought). Competencies are suggested in resilience adaptability, realising prosperity, recognising opportunity, technological and market innovation. There is also emphasis on increasing productivity whilst also developing environmental credentials. Key areas of resource use efficiencies and risk management are supported to maintain focus on increased productivity. Three drivers of thriving innovation, quality jobs and protecting environments are framed amidst a host of constraints through which drivers need to be realised. A new era of farming practice requires a new set of competencies including relationships between research management practice and stakeholding, learning and evaluation.

Of all the threats outlined by interview participants the most important seems to be the existence of capabilities in dealing with climate uncertainty and less predictability. This is a core concern against which all other dimensions of threat are linked including retaining productivity and food security, mental health and community wellbeing, competitiveness and business sustainability, and reactionary rather than anticipatory politics. Dealing with climate uncertainty and less predictability seem to be the main threat through which a range of research conceptualisations align. Better understanding of environmental interactions, recognising social-economic consequences, improving capacity for shared responsibility, building local relevance of policy and science, and facilitating new research relationships all require a certain finesse in handling uncertainty and a lack of predictability.

Furthermore issues arising in the way research is currently valued are stemming from a tradition of prediction and control which is increasingly losing purchase over experience. Thus there is a sense of valuing research that is moving from a static environment of knowledge production focused on underlying causes to a dynamic one of understanding complex interactions and the patterns they give rise to. At the moment research is valued in a diversity of ways from the tradition, focused on ongoing production efficiencies, to concerns linking present decisions with future outcomes by understanding the complexity of the situation. Value is also placed on realising the conditions through which innovation could be optimised, facilitating a shared vision for investment, and in developing dynamic modelling capability that can support an understanding of the interaction between climate change biophysical and social worlds.
Some of the areas in which research links up are viewed in the context of developing capabilities for dealing with climate uncertainty and less predictability. This represents an approach that builds CCA research practice through a model of organisational learning. There are four areas in which this approach is being realised through: recognising the difference between formal and informal research networks; recognition of new relationship through research, rewarding feedback and collaboration; connecting across disciplines, concepts and models; and organisational structures to support integration.
Chapter 5 Climate change adaptation research: discussion and conclusions

This chapter develops findings from the interviews into a framework that responds to the key research questions. The discussion elucidates the current situation and points to how future research and research management practice might benefit from systems theory and praxis.

Assumptions about collaborative capacity and contradictions that emerged from the different perspectives on CCA research will be addressed. For example, the research established that there was limited conceptual integration of CCA research despite the good intentions of the researchers and directors. This section also addresses some of the significant differences between what’s said and what’s done, and what’s done and what’s reported in relation to CCA research. The means used to frame research and its delivery, and hence how the complexity of practice is understood, are also discussed.

This account arises from the methodological choices that have been made i.e., it is qualitative and the research was organized as a systemic inquiry (see Chapter 1) into what DPI CCA research actually looks like in practice. In this chapter direct descriptive questions as well as reflective questions on how CCA research is undertaken are dealt with.

5.1 Responding to the key questions

During analysis attention was paid to the differences in perspective between participants from FFSR, wider internal DPI and external DPI as well as to different metaphors and framings used in response to the question themes using grounded theory methods of constant comparison (Strauss and Corbin 1998). Two different types of interview question were intended to elicit descriptive and reflective comments from participants in a way that responds to the three analyses used in application of SSM (Checkland and Scholes 1999; see Chapter 3). Table 5.1 provides a summary of the descriptive and reflective content of interviews structured by the set of themed interview questions. It outlines the main discourses emerging from participants responses to each of the themes.

This inquiry structure provided an opportunity to analyse what participants say they do as well as offering a deeper reflection on their practice. Such an approach enabled analysis of the tacit and explicit constraints and opportunities for developing a framework for systemic theory and praxis. To reiterate, the key questions were:

1. How do participants ‘construct’ the problem of climate change, what is the context in which they are motivated to respond to climate change?
2. How is climate change research rewarded; what are the significant roles for climate change researchers?
3. How can we analyse the relational dynamics as evident in the types of influence different interests and groups have over climate change research?
Table 5.1 Summary of descriptive and reflective discourses pertaining to three analyses

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5.1.1 The problem situation

*How do participants 'construct' the problem of climate change, what is the context in which they are motivated to respond to climate change?*

Climate change was seen as a problem of maintaining productivity and food security against changes in climate and development pressure for land and water resources. However participants expressed duality of purpose and some conflicting priorities in these accounts, on the one hand to increase productivity against environmental constraints and on the other to reassess the whole global economy in which productivity drivers were embedded. The implications for research were in supporting farmers’ response to changed environmental conditions such that production could be maintained at existing levels. In reflection the issue of food security and resource competition included the problem of connecting research questions to building capacities to act under conditions of uncertainty. These included developing capacities for understanding of interactions between biophysical and sociocultural environments such as the effects of privatisation on the availability of water for agriculture. Participants were motivated by a sense of increasing awareness of how adaptation might be realised against biophysical and sociocultural constraints. For example, the threat was expressed by one manager in terms of the ‘reduced ability to produce food’. However another underlined the threat as a ‘failure to act’, e.g., in terms of the ‘failure to balance off needs of water’. An internal stakeholder also perceived water as the ‘biggest impact’ which had driven change in practice where farmers ‘had no choice’ but to modify their farming systems. Similarly another stakeholder had seen the emergence of carbon accounting and improved productivity as a case of ‘doing more with less’. There was an added sense of optimism in reflection of environmental constraints for realising opportunity in ‘some good news.
stories’. An internal stakeholder recognised that ‘plants grow faster and bigger under high CO₂’ along with ‘opportunities for carbon sequestration’ resulting in a ‘better understand the soil profile’. However there was a mixed response here where external stakeholders saw the challenge on food production as part of reconsidering trends in the ‘daily economy and consumerism’ connecting global food trade and its environmental costs. The ambivalence associated with dealing with such conflicting priorities was not addressed by strategy documents which indicated more of a ‘business as usual’ framing. The focus of strategy was on realising opportunity against constraints without providing a particular reorientation to the direction of economic development and food security under future conditions of climate change and its potential impacts on supply and demand.

Participants also constructed the threat of climate change as one of community health and well being and as an important issue, for example, to be able to accommodate a range of risks to which farming and regional communities were likely to be exposed to in the future. These issues were driving a need for accommodating uncertainty and recognising the complexity of the situation. In reflection CCA research was conceptualised as addressing a need to recognise the socio-economic consequences of climate change. Such understanding was sought to shift the debates on climate towards a greater responsibility for knowledge sharing and to stimulate creative thinking on overcoming constraints. Participants framed a sense of social upheaval through ‘coastal movement of all agriculture’ in addition to the ‘extreme heat and the threat pose[d] to health and infrastructure’ embedding a concern about community stability. At another level a manager’s concern was directed at an ‘increasing population’ with the risk of ‘wars fought over water and food’ against another’s with ‘a lot of unknowns [and] uncertainties’ making it ‘difficult to stay mentally healthy to stay in business’. It was recognised by one of the internal stakeholders that understanding was moving ‘beyond biophysical change’ to ‘recognise significant economic impact’ associated with climate change. According to one of the managers this was not a simple ‘we fix up the job’ framing DPI as problem solvers, as ‘its all the downstream and upstream impacts’ that result in awareness of the issues as ‘increasingly complex’. Together these perspectives underpinned a need for knowing where and how to create a socio-economic environment to facilitate change towards new types of framing operation. In practice there were institutional constraints to recruiting economic expertise to FFSRD where this capability was perceived to exist in another area of the department, despite its being a research need for those working in certain areas of VCCAP. The strategic documents did little to support understanding of how socio-economic consequences of climate change would influence adaptation responses. Furthermore there was no explicit understanding of what a well adapted future farming operation might actually look like. It was apparent that people were working within a context which was highly uncertain and the skills and capabilities needed were evolving out of the context in which the climate change issues were being framed.

Additional concern was expressed about the impact of climate uncertainty and loss of predictability of the future based on the past. This was also reflected as a wider context of change not just in climate but in market dynamics and global financial security. The condition of unpredictability in which the problem is manifest has motivated a desire to support decision making under conditions of uncertainty. In reflection of such constraint participants conceptualised CCA research as improving capacity for sharing responsibility on research design and development beyond traditional research relationships with individual industry partners. A set of participants were motivated by a need for a higher degree of literacy between local knowledge and scientific expertise that could strengthen capacities for action. They recognised the importance of engaging people in the understanding of science such that they can view their own environment in light of current climate science. One of the external stakeholders recognised the significance of ‘extreme weather events’ and their ‘frequency and severity’ as realising ‘a sense of unpredictability’. A manager also realised the difficulty for farmers to have to ‘commit to
something [where] you don’t know what’s going to happen’. From this perspective there were ‘real communities that don’t know how to respond’ to the threat of climate change. An internal stakeholder was motivated by ‘helping general understanding’ and ‘helping the literacy of our stakeholders’ to be able to contextualise and interpret ‘main climatic patterns’. However it was important for another internal stakeholder that farmers were ‘drawing on their own experience’ as a resource to ‘try and make sense of the world’. This was expressed as a need for reflection against the trope of farming outlook as one of ‘eternal optimism’ that rainfall conditions will return to a state of reliability. It was important to start to embed farmers own experiences in understanding climate models and to enter a genuine discussion and realisation of how to plan and act under conditions of uncertainty. These discourses of new research relationships and facilitating opportunities for shared learning between industries and government, although recognised as important dimensions in the national context document (LWA 2008), are not given explicit attention in the DPI strategy documents.

Some participants concerns were also framed by a discourse of competitiveness in access to water resources, international trade and sustaining businesses through changing consumer demands on social and environmental values. The same discourse was present in the strategic documents of business sustainability that formed part of the dominant approach to research, development and extension. Transforming businesses under conditions of constraints would require carefully planned and monitored actions to ensure they did not produce adverse effects that were less likely to sustain businesses into the future. In reflection research was conceptualised as building local relevance of policy and science through closer engagement of those with knowledge needs in the design and development of research questions. Together these perspectives represented a delicate environment in which to construct policy and to sustain already vulnerable businesses. However different perspectives were offered by stakeholders. For one of the managers the ‘policy impact of emissions trading’ was a constraint upon farmers who had ‘average crop successes of one in ten’ and where businesses could not sustain a ‘carbon tax on top’ of that. For one of the internal stakeholder the challenge is ‘our international competitiveness’ that had implications in the ‘challenge with emission and supply chain’ across the globe. On the other hand there were external stakeholder concerns about ‘how other nations perceive[d] us’ in relation to decisions about emissions trading and how that might impact international relations. There was a sense that policy making could be made more robust by considering the ‘solution-making’ as something ‘happening at the local and community and regional level’. Yet there was not much evidence of that where research was ‘too centralised at the minute’. A perspective from one of the managers was that ‘people are being bombarded’ in rural communities with ‘so much information’ that and they ‘don’t know what’s reliable’. Against this confusion there was concern that researchers ‘can only try and anticipate and predict’ while ‘there’s a lot of uncertainty’ and in hindsight their ‘messages aren’t convincing or don’t eventuate’. It seemed important that managers recognised that experts were vulnerable to failed predictions and that climate change issues exposed the limits of knowledge or capability to predict futures at the level of detail required to support local actions. These comments indicated the importance of having more open research relationship such that uncertainty could be more fully recognised and knowledge discerned from ignorance.

There was also a perceived problem of reactionary politics potentially leading to poorly rationalised spending and policy making rather than a more anticipated development of strategic planning and foresight to cope with uncertain and extreme future events. In reflection of these concerns participants noted the importance of facilitating new research relationships to build capacity for learning and to open possibilities for creative thinking on adjustment and innovation. Managers were aware that the issue of climate change ‘has provided a lot of funding’ where ‘we’ve [government] swung the pendulum that way’ to which there was now an emerging ‘gap in terms of R&D funding’ which was perceived as
‘an internal type of threat’. Furthermore there was concern that ‘changes are subtle’ and experience ‘may not realise the full impacts’ which underlined the problem that ‘private industry tends to react’ rather than anticipate future risks. It was an issue reinforced by one of the external stakeholders who was concerned about the ‘the more extreme event driven’ reaction to climate change which could drive an inappropriate political response. Another added the importance of ‘nailing underpinning assumption’ such that they could be ‘constantly questioned and debated’. This was also suggested by an internal stakeholder in relation to the context; ‘its evolving’ with a need to understand ‘biophysical changes’ and ‘how they play out in natural and built environments’. Another stakeholders was motivated to generate a ‘better understanding of potential opportunities’ which could be supported by ‘visualisation and modelling techniques’ as a means ‘to understand what the future might look like’. From this perspective research was important to ‘start having a practical discussion around strategies’. Participants were motivated by realising research as a question of solving problems together by acknowledging uncertainty and government becoming involved in sharing the risk. This seemed to be an important dimension of shared responsibility where communities are supported in understanding and taking actions to adapt and are not isolated from research activities and policy decisions.

From the descriptive and reflective lines of response it seems that the ‘problem of climate change’ is perceived by participants to be much bigger than research is able to address. There are issues in connecting up research activity to those with knowledge needs so as to increase the rate of knowledge exchange and expedite the processes of change required to accommodate anticipated changes in climate. As was explained by one participant there was fear that research was just ‘tinkering around the edges’ as the problem grew ominously larger partly fuelled by a lack of concerted action on climate change. Nevertheless it was clear from participants’ comments that a desire existed and conditions feasible for realising that climate change meant significant social and economic actions were needed. As was noted in descriptions of threat the impact on food security and livelihoods required some preparatory and strategic thinking and to build upon existing momentum of those willing to innovate and increase the range of opportunities for agriculture’s survival into the future. At the least it would seem that perspectives gathered in this study would substantiate greater investment of research with the people it was intended to benefit, although it was recognised that there are considerable constraints in realising a closer interaction between research and the contexts in which it is used. For example there were organisational constraints in getting conceptual integration and interpretation of differences in understanding and framing of research questions at the level of research management not only between different stakeholder interests but internally across different divisions and disciplines. Some of the constraints are given more clarity in the response to the next two questions which situates the problem in its social and political context from the perspectives of people interviewed.

5.1.2 The social situation

*How is climate change research rewarded; what are the significant roles for climate change researchers?*

There were two important aspects that participants raised about the culture and practice of research in relation to how it was valued by stakeholders. Firstly, it was noted by one of the managers and supported by illustrations offered by others that there was an interest in knowing how CCA research had changed some tangible aspect of decision making with stakeholders. This was referred to as an issue where standard evaluations of research were not able to capture the individual interactions between researchers and users of research knowledge in which concerns and understanding of CCA were exchanged. A second and related concern was that an overwhelming denial of climate
change amongst most Victorian farmers was driving attention to changing behaviours before changing beliefs about whether climate change was real. This meant having a different type of conversation about climate change with stakeholders and resulted in DPI participants referring to climate variability rather than a more permanent change. Both of these considerations indicate the importance of face-to-face or interpersonal interactions between researchers and people they had hoped to influence through CCA research efforts. This is an important finding from this analysis where research typically does not focus on interpersonal communication as core to the values of research practice. Communicating with research stakeholders is largely configured as an ‘add-on’ to the main activity of research and not fundamental to the way researchers come to understand their place in the community. The issue of CCA is of particular significance because it presents a profound uncertainty and will require a great deal of learning across a range of issues impacting agriculture, ecology and regional communities requiring closer interaction and trust between researchers and stakeholders.

Participants recognised a degree of diversity in the stakeholding in CCA research raging from policy makers, to community, other areas of government, other researchers and farmers with different views on climate change. There were certain distinctions made on how CCA research might be perceived based on differences in belief systems, in geopolitical contexts and different areas of knowledge need. As a result participants’ descriptions surfaced a number of areas in the way research was funded and how research management practice could be supported including planning and investment for averting the worst of food insecurity. One of the research managers recognised the importance of CCA research against the ‘future of the world's sustainability’ governed by ‘food and access to natural resources’ and as a matter of global priority. However the view of global responsibility was contrasted with the local scepticism that climate change was real. DPI participants felt they could deliver value to sceptical stakeholders by focusing on production efficiencies. It was underlined by a set of values driving recent practice to improve productivity, reduce resource use and reduce input costs as an ‘age old story’ of ‘being able to produce more with less’. However this view was juxtaposed with another perspective recognising that changes in climate ‘still has to interact with all these other uncertainties’ which responded to the concern of whether adaptation had made farmers ‘more resilient to other shocks’. Yet one of the external stakeholders saw a stronger need to invest in alternative forms of agriculture and to reconsider the models of development for shifting towards more localised food supply and consumption as a global responsibility to managing climate. These different perspectives raise different issues for research focus which has implications for the way DPI frames CCA research activities. On the one hand DPI addresses climate change sceptics with discourse of production efficiencies and on the other opening up discussion to a higher degree of uncertainty in food security and risk management under conditions of climate change.

In reflection participants associated a concern about changing behaviour where research would not be valued until the future when it had proven to support agricultural livelihoods. This was an issue for those involved in decision support modelling which did not have a reliable source of funding for actions to be taken in the future. As one of Victoria’s major exporters with significant capital for investment the grains industry rewarded research for supporting existing industries. For those that wanted to break out of traditions, however the opportunities to being supported by CCA research were more remote. According to one of the internal stakeholders there was little investment for research that ‘finds’ and ‘connects’ people in a way that facilitates and engagement about adaptation that could leads to innovations in agriculture and framing practices. It was concerning for another that farmers are changing their practice ‘as a result of 13 years of low rainfall’ in the sense that ‘their behaviour is as if climate change is real’ and yet there was little opportunity to focus on future risks. On the other hand some farmers have increased ‘their productivity under climate variability’ which indicates that some adaptive actions
have been realised. These actions are not necessarily the result of DPI research activities and understanding what has actually occurred in such operations would be of value to the future design and development of CCA research. These differences represent some of the difficulties in being able to engage farmers in rewarding and defining a role for CCA research. For one internal stakeholder researchers ‘have to context the research activity so that those clients can better understand climate debate’. However from another perspective ‘there’s also people who are right on board’ and ‘those people will place a higher value on what we do’. The issues of CCA research working in a space that was not in direct alignment with industries or of opening up public funding for research when the majority of farmers did not believe climate change to be real left a significant gap in being able to conduct research that did not demonstrate an immediate or short term benefit. This has important implication for FFSRD as a research organisation and how it might gain the commitment of funding sources into longer terms analysis of adaptation and its effects in realising sustainable livelihoods.

Research was thought to have strategic value for helping people adjust to the effects of changed environments which would be realised differently in different regional and industry contexts. One way of the ways of assisting people adjust was seen as better modelling of anticipated change through understanding of historical patterns and incorporating new environmental conditions. However a historical view of change was juxtaposed with another view reflecting a type of stakeholder which had needs for understanding the complexity of the situation as it presently stood. In this case research supported those with a desire to better anticipate the impacts of climate and build capability to respond to future risks. One use of modelling was directed at industries for understanding changes in environmental conditions in which ‘new traits for future plants’ could be modelled and identified. The IPCC anticipated this kind of research activity supporting decisions in the context of climate change through understanding and supporting changing agricultural locations and plant varieties. In this context CCA research was directed to ensure the future survival of grains business in Victoria in new production locations under the framing of a ‘migrating climate’. An alterative proposition was by one internal stakeholder who acknowledged that ‘our fossil fuel resources are not infinite’ and that ‘sooner or later’ we ‘have to get to grips with the fact that we can’t consume liquid energy in the way we have done’. But not all felt that this constraint was compelling farmers to act, for example, ‘it gets a bit more subtle’ where ‘farming by its nature requires a very optimistic outlook’. From this perspective agriculture - which is framed as ‘man’s ability to harness the environment, subjugate it to our whims, so we can grow our crops -, in its current form was dependent on water. Water was seen as a critical driver of change which motivated farmers to act, whether it was to increase water use efficiencies and adopt technologies that could support agriculture under a ‘water constrained environment’ or to give up the challenge. One of the internal stakeholders acknowledged that they were having different types of conversation with farmers depending on their outlook. In this assessment of the situation for research, this person was guided by a ‘much greater need to help people cope with big change’. There are divergent perspectives here that indicate that not all DPI CCA research ‘clients’ have the same way of thinking about climate and present a different set of demands in CCA research and its communication. On the one hand there is a future orientation of modelling to serve and support decisions making in the present and on the other there is a need to realise the history of the situation as it has arisen to better understanding what constraints farmers are currently working within. In both situations innovation is seen as a result of changes in context which requires getting out and seeing how farm operations are coping, to see the effects of government policy and other mechanisms designed to facilitate change as an ongoing learning process.

From another perspective removing government and other social impediments to change was something that would benefit farmers and businesses directly. In reflection of these
concerns there seems to be a need to understand what market and other cultural conditions provided for optimising adaptation and where regulation may be needed, not just in the short term but over a longer period. Recognising and removing government impediments to people adapting was an important means of making a difference yet there were issues in being able to identify just who was adapting. In reflection this dimension was supported with another which recognised and enabled the conditions through which innovation was optimised. For one of the managers CCA research had a role to perform in ‘removing the impediment’ which required finding where ‘there’s a block that government has control over’. However from an internal stakeholder perspective this cannot be assumed to be the same in all places. In this case research had to be designed to ‘make sure it helps people respond in their own way’ and there are differences in ‘all different nooks and crannies’ of Victoria. For some this may mean a need to ‘change the business structure’ or that we ‘might have to re-adjust how we finance this’ and think about ‘farms spread across climate zones’. Yet in the present context, as one of the managers viewed, ‘vegetable growers wouldn’t care a continental’ about climate change. Their concerns were focused on ‘the price of broccoli in the market tomorrow. However this manager felt that he had broken through the barrier by enticing change where there ‘might be a way to add value and differentiate your crop on health benefits’. These expressions illustrated how as practitioners involved in research you ‘have to think very practically about how you communicate’. If research was framed as ‘something that contributes to [farmers] bottom line’ then CCA research activities were thought would be valued by stakeholders, e.g. where they are now ‘starting to net their crop’ and its ‘all starting to pay dividends’. The focus for these managers and stakeholders has been an emphasis where there ‘has to be some sort of short term pragmatic advantage’ on the ‘issues of the effect today’. However against these short-term self interests there was a perspective in which research was thought to be valued by ‘industry itself, as good citizens, they’re concerned about long term impacts’. Action in the present that provided short term benefit must be reconciled with future impacts such that maladaptive action is not taken, worsening the choices for future sustainability of livelihoods. It might be that returns in the short term are better utilised for changing existing systems for longer term security. However this is not typically the kind of discussion that DPI FFSR has with its stakeholders and raises issues of communicating CCA research that starts to engage in discussion about business and environmental risks. In this context technical understanding of risk is not the end point of communication but its beginning as discussions are opened up on responsibility and management of risk.

Linking present and future choices was an aspect addressed directly by participants that could benefit farmers as well as stakeholders in policy, planning and development. However there was limited attention to the significance of a carbon trading environment on where agriculture was developed and how carbon trading could support diversification of land use. It was thought that this could be supported by developing leadership opportunities in which the transition to new industries and practices might be realised. Yet there were contrasting perspectives of this. From one managers’ point of view research can add value where ‘they do want to know what the future will look like’ which requires a kind of ‘tactical management strategy for the here and now’ and then ‘linking that to the future’. It was a perspective that supports the notion that farmers can ‘have a sustainable business into the future’. However it was ‘also for the community’ because ‘if we don’t adapt there’ll be food shortages in the future’. Another manager drew attention to the importance of recognising that the ‘future’s going to be different from the past’ and that we need to be ‘careful how much we invest in it’. This cautionary view was contrasted with another who sought greater acknowledgement from the community that ‘a fair bit of state’s wealth comes off the land’. In the present context this was a challenge made real by the concerns of immediate actions that would result in an overall increase in greenhouse emissions. There was a need for some trade off in a carbon economy, as reflected in the earlier comment that focussing on production efficiencies was rewarding
and supporting business as usual. This notion generated from opportunity in future carbon and water markets was indicated in documents although not picked up directly by interview participants. With the background of issues in water trading, in hindsight, it is important to understand the way change is framed and realised on initial assumptions. In this context those involved in research and its design have not yet incorporated consideration of emerging markets and how they will interact with farming practices and their sustainability. This suggested that research within government needed to be more attentive to change in the external environment and that opportunity to initiate discussion on market emergence and its effects may need to be supported.

Furthermore there was a need to increase recognition of the importance of local agriculture to the future sustainability of Victoria. Linking policy to the farm context was an important way of fast-tracking the conditions through which greater sustainability of livelihoods could be realised. In some respects creating opportunities for developing a shared vision was already tested in other areas of agriculture and had proven successful in facilitating multi-stakeholder investments in research programs such as Vital Vegetables and may have also been the case for EverGraze. These programs were regarded as successful in linking production goals with health and environmental outcomes. One external stakeholder valued ‘being able to bring together a number of people’ as those who ‘had a common interest in climate change’ offering a ‘diversity of perspectives’ and ‘getting to different sections of society’. This represented a more ‘participatory research’ approach ‘where we open up to and let the maximum amount of people to participate’. It also reflected a ‘vertical and horizontal integration of the research effort’ directed at ‘identifying priority’ and ‘cornerstone capacities’ as a means for better articulation of policy that can result in long term effective action. However the view of longer term action was contrasted with a managers perspective that its difficult to get ‘investors thinking a bit further out’ as they typically ‘address issues in a time frame’. These differences were reinforced by another internal stakeholder who recognised one type of farming stakeholder as driven where a ‘new wheat variety might keep them in the game’. However for this participant there was also ‘a broader audience that needs another discussion’ which reflected thinking on a ‘higher order question: are you happy doing what you’re doing’ and ‘is your family supportive’. From this perspective there is a need to have a process for visioning to enable people to consider and realise what trade offs and design elements are needed to support short and long term adaptation. These findings also indicate the importance of closer community engagement and techniques to accelerate the level of change required within the constraints of current understanding and practices.

Some experiences with creating opportunities for people who would not otherwise interact to work collaboratively on realising innovations against constraints was seen to yield good result. Nevertheless there were difficulties on knowing how to identify and find such people in order to get them together. Experiences were found to have very positive effects where otherwise disconnected people were brought together with ‘some of the most amazing results’. One concern was how such opportunities could be sustained beyond DPI’s presence to ensure that innovative thinking and new networks of engagement could flourish. Developing new techniques for engaging communities in various aspects of understanding climate impacts and adaptation was also seen as a critical element in which research could make a difference. External stakeholders expressed a view of ‘visualisation techniques’ that were more successfully ‘engaging people across multiple fences’ who ‘feel connected to the issues in different ways’. This contradicted an internal stakeholder who found that in reality DPI ‘only spend about 10% on communication’. With out having this kind of outreach effort there was ‘too much focus on industry level’ with government ‘caught up with co-investment’. This was concerning from the perspective that ‘people will choose future not right for those industries’ and their interests are not necessarily being served where ‘government could be captured’ by its
industry-based stakeholding. This more critical view of how research currently functions was contrasted with an external perspective that recognised the need for ‘policy and community to help drive the questions’. Furthermore there was concern where government has ‘got all these single focus polices and regulations’ and the only place where ‘they work in totality at the farm level’. The implications of all these ‘different policy activities intercepting at their property’ influenced the perspective of farmers who ‘preferred us to come with a joined-up government’. Communication as a means of connecting up with various communities of interest in DPI activities was clearly an important area of engaging stakeholders and realising opportunities for change. However there were divergent perspectives on how successfully this was being achieved. Currently it would appear that DPI has limited capacity to argue for the sorts of resources required to increase the rate of interaction CCA research has with its diverse range of clients.

Participants also recognised the development of dynamic modelling capability as something valued by stakeholders that had hoped to better understand possible futures such that they could start planning and taking anticipatory action against risk. It was clear that this type of stakeholding was distinct from that in which the focus remained in generating future efficiencies. On this point it is notable that the annual update of the FYS indicates an anticipated decline in productivity triggering a refocus on the role of government toward better performance and engagement with those with knowledge needs. One of the internal stakeholders tackled the problem as one of supporting industry through change which did not require a particular belief in climate change. This supported a view that ‘we can still increase the value of Victorian agriculture but it will be different and it won’t be with everybody’. In conjunction with this view one of the manager’s felt that they supported decision makers by ‘looking at probabilities of getting a yield with different management practices’ so that they could ‘see the penalty of going for one option over another’. Yet there was another perspective of valuing research that was more hidden and that was the change that stakeholding made to the type of inquiry researchers conducted. As one manager noted ‘breeding programs aren’t in government areas now’ and so you ‘tend not to get the diversification because it’s too expensive to do that research’. Here private actors in research did have an influence on how research was practiced. According to this manager CCA research worked in concert with these types of situated decisions by driving questions on how plants are ‘going to perform over the landscape’. It seems that models were being used in a predictive sense to construct a future environment and then develop characteristics in plants to suit a variety of possible conditions. This was clearly a risk management context that favoured reduction of diversity over increasing the range of possibility for future plant production. One of the implications of using climate models projections as forecasts is the possibility of locking in particular technological solutions to problems that might not be realised in the ways they have been anticipated with current knowledge.

These findings demonstrate a need for recognising historical patterns such that futures can be better designed in accord with understanding of how research and development has been socially constructed in the past. Considering various traditions and how they have changed over time such as the sources of funding for research and understanding the contexts in which they have changed can generate a more holistic view of how research outcomes are socially shaped. A better understanding of difference in context is required to best suit research to particular problems. Research can contribute to an understanding of the complexity of the situation as both socially constructed and with real and tangible effects. It is important to recognise that the way problems are framed and research developed will produce outcomes that lead to different trajectories of agricultural and regional development and performances of sustainable livelihoods. Seeking out and getting people together to create innovative spaces for research design and development will require less attention to ‘the usual suspects’ of industrial agricultural traditions and
new sensitivity of government to those who are making a difference in terms of realising sustainable livelihoods in agriculture. Thus there is a need for some dynamic modelling capability where models are not representation of reality but of possibility that are used to open up conversations to support action that can be tested and reviewed in the light of experience. This offering supports that theory can only provide a partial guide to purposeful action where it is necessary to be able to recognise that assumptions can be wrong and theory reviewed in the light or experiences and evidence. This creates a framing of research that is open and contingent upon individual choices made and their collective effects. It requires a different kind of relationship between research, its stakeholding and research management practice.

5.1.3 The political situation

*How can we analyse the relational dynamics as evident in the types of influence different interests and groups have over climate change research?*

It was noted that there was little support given to collaborative work which was seen as an important part of government research activities in working more closely with a range of research stakeholders to support decision making. This view of research value was worth considering against the management of DPI internal capability. It presented a challenge for researchers having to realign their research interest to new policy questions. There was a sense here that big collaborative projects and their structures had been defined at a higher level of the organisation but facilitation of processes and how they are supported is not as well considered. There is an implicit concern here that people are not coming together in an autonomous fashion to open up inquiry, leaving the question into how integration of knowledge can be supported. Nevertheless project reframing often ended up with novel explorations of problem and collaborations that brought new ideas in research to the fore. The extent to which they were supported depended on the advocacy of those involved rather than something the organisation was actively seeking. In reflection research was seen to be linked-up through formal and informal research networks. These included strategic alliances at the national level between research organisations, industry bodies and government departments and agencies. Yet some stakeholders were concerned about maintaining the conditions required to support the emergence of networks that were less formal yet strategic. In many respects managing research capability resulted in a tendency to ‘rebadge’ existing projects with new labels to support what was internally valued as existing research capability in the organisation. One of the research managers noted that there were ‘synergies across industries and across divisions’ but that DPI ‘probably don’t use it as well as we should’. An internal stakeholder illustrated the issue as people ‘tend to want to hang around in like-minded groups’ and in order to stimulate innovation ‘some people that need to hook up that have got a similar vision’ have to be found. The same issue was viewed by another internal stakeholder of how ‘you make those connections’ where ‘people who are ready to go are a bit isolated’. On the other hand it was recognised that funding was ‘used as a ploy’ to try and get people together to drive innovative thinking. It was also noted that some of the more formal means of integration, such as that coming out of national programs ‘have forced some national integration’. The issues of creating conditions for novelty and cross-industry and cross-sector innovation are not particularly supported where ‘national networks’ are ‘driven by agricultural industry’ and the focus or purpose of networking is ‘to try and avoid duplication and build synergies’. This has important implications for how the various strands of CCA research are brought together within the DPI and other areas of government. It has been noted that CCA provides focus to explore the issues in a way that they have not been explored before, e.g., in collaboration between plant and animal science in greenhouse gas analysis. However the breadth of issues presenting to people in communities engaging CCA would suggest a need to articulate and prioritise actions that can support greater sustainability of
agricultural livelihoods that are as yet unknown. At the moment these issues are not
given programmatic attention in the DPI. The problem may be better configured in which
interpersonal communication is important to creating spaces for engagement on new
research relationships

Participants’ description of research also focused on using evidence to change behaviour
as an important way of grounding research activities. However in reflection there was
recognition of new understanding through research relationships that were already
occurring. In this area participants reflected on how, in their experience, new knowledge
was generated through focus on climate change issues and emission reduction problems.
Yet there was limited questioning of whether actions in the short term would also support
farming operations over a longer period. Furthermore in reflection of generating
collaborations that had potential to generate new forms of industry there was concern that
such connection would not have the momentum of political lobby and therefore had
limited influence on mainstream politics. One of the interesting things about counter-
intuitive evidence was framed from an external perspectives as ‘decoupling mental
models’ or expectations based on current modes of understanding and practice. From
this perspective there was limited capacity for ‘shared understanding’ and the role of
problem-focused or ‘targeted research’ which opened the possibility of re-conceiving the
built environment and for developing ‘research to enable a host of innovations’. An
internal stakeholders was also concerned that farming was ‘still working within the
bounds of existing systems’ and that the visibility of a threshold through which
transformation might move was still subjected ‘to great constraint that they stick to their
current system’. Even where there was a perceptions of effective adaptation, where in
response to dry conditions in the north of the state vineyards were ‘used to doing a lot of
preparatory watering’, the focus was still on how environmental change has ‘changed the
options the farmer has to maximise their productivity’ Actions instigated on the basis of
CCA research were still configured by the view of trying to ‘sell it to them on the basis of
increased returns’. One of the managers recognised how different areas of research
were ‘starting to work together’ as a result of issues of climate change on how ‘our
knowledge of tannins in grape skins’ could be applied against knowledge of ‘tannins in
fodders and pasture’ as a basis to change animal diets and reduce methane emissions.
From an external perspective there was a need to focus energy on thinking about the way
issues are framed and how realisation of innovation is created in new types of
relationships where ‘the way we prioritise things will lead to connections and also
disconnections’. Currently this was reflected in the view that ‘our economic system’ and
the way of life it support ‘is currently coupled to the global climate system’ which required
radical transformation to realise something that was more sustainable over the long term.
An important dimension of this understanding was that the way things are prioritised and
connected up ‘can either constrain or enable different ways of thinking’. Yet there was a
radically different view from this more future oriented perspective where ‘state has got
two or three hundred years of coal sitting in the ground’ which in the current context of
free market competition ‘someone else will come and take it off us’ if we don’t put it to use
ourselves. From another perspective one of the weaknesses of such consideration is that
a ‘lot of straight line trend forecasting’ is what is used in policy making, rather than to
examine how trends ‘inform different ways of developing policy’ which in turn generate
trends. From this perspective there was not enough consideration of the relationship
between policy and trends to realise how ‘research and policy is closely linked’. It was
clear from some interview perspectives that much could be gained from facilitating
strategic research relationships in ways that connected up stakeholders that would not
usually interact. This was done around a particular framing, e.g., through linking health
and environmental to production outcomes in the case of Vital Vegetables and Ever
Graze programs. Yet it was concerning that processes for facilitating collaboration and
conceptual integration, for example through workshop with diverse stakeholders and
disciplines, were not part of the strategic management framework. In order to gain the
most from collaborations in contributing to research design, processes that are facilitated to break down boundaries between differences in problem framing and open up new areas of issue interpretation and conceptual integration would be valuable.

Research on the ground was also related to understanding the implications of forecast and how that can improve decision making. This included working through modelling and other techniques that enabled stakeholders to think about futures and what actions might be taken to realise desirable futures. One aspect of linkage which was thought to be lacking was in the area of rewarding stakeholder feedback and collaboration. This was an area of concern where these dimensions were not adequately recognised in the organisational culture or structure of DPI in shaping research directions and impacts. Traditions of monitoring and evaluating government performance were based on a model of business accountability in terms of project milestones and projected outputs of research. However in a context of uncertainty about how programs were implemented there was a more dynamic evaluation need that did not have pre-existing criteria. For one of the managers this was framed as realising ‘different points of decision’ and generating ‘a different range of options to make’. However it was also seen by another manager as generating means to ‘understand the implications of the consequences’ of taking certain decisions. Some concern about how decision could be supported was through better understanding of the implications of actions taken such as ‘how successfully we integrate the climate and emissions related information’ or ‘how do we respond and adapt and change’. It also concerned those involved in government in understanding ‘what’s our adaptability in our policy’ and ‘where’s the flexibility in using our policy space’. For one of the managers the implications of forecasting were much more open ended where those involved were ‘coming to not consensus but coming to sort of an agreed picture’ of what might happen and then ‘still going out to communities to get a reality check on that’. However concern was illustrated in the view of one of the managers where they ‘keep hearing different perspectives’ on what research needs are, which confronted them in knowing ‘how do you put this into a framework’. For example, they might go ‘and spend millions and millions of dollars on this genetically modified programme’ and then when they take it out they realise ‘that the industry’s not going to be prepared to take the risk’.

Others also realised that you ‘could end up with some conflicting outcomes’ which are not realised in the process of research design but ‘when you draw it up and apply it at the point of impact’. Some of the strategies used to accommodate these issue of practical implications of research for stakeholder included ‘specifically put extension people in beside our researchers to look at how’ the research interacted with what they were actually doing. These experiences led managers to the perspective that ‘you need that involvement of your in users and your intermediate users in the research’ to ‘understand that it’s not a yes-no answer, there’s a lot of grey’. Against this perspective was the view that ‘scientists are not necessarily good communicators’ when it comes to bringing knowledge out into the everyday context. For example, an internal stakeholder stressed the importance of their ability to ‘interact with farmers at the ground level’. This was seen as particularly important to the development of practical understanding of ‘theory’ that ‘should be fed back into the design of R&D’ where currently ‘it’s a bit of brokenness about that cycle’. Monitoring and evaluating the efficacy of programs implemented in different ways in different contexts could be supported by some of the views offered here where farmers’ feedback on the efficacy of program could help in their redesign. There was an interest in knowing how the programs were taking effect and what ways government could modify programs to accommodate different outcomes in different contexts. It was also seen as increasing the possible performance of environmental outcomes through this feedback process in which communities played a role in self-evaluation in the realisation of sustainable livelihoods through CCA.

Participants also noted how research was contextualising and engaging stakeholding directly such as checking models against farmers’ perspectives of local climate and plant
performance. Such a view was reflected upon as connecting research across different disciplines, concepts and models represented an area that was often assumed to be relatively straightforward but proved to be difficult to realise in practice. This reflected a lack of theory on just what multidisciplinary and multi-stakeholder research entails. There were positive views of engaging farmers and others in farming communities with climate science as ‘fast tracking climate change adaptation’. This represented a picture in which action was ‘happening at that context locally’ and reflected an approach of ‘brilliant results of that participatory action research’. Others also supported this perspective of connecting research to local contexts to ‘enable people to see and touch and talk’ of the meaning of CCA. Furthermore there was a range of ways research was being recognised by stakeholders including a ‘more narrative research’ that focuses on ‘the way people live and work and do things’. It was also thought that ‘trans-disciplinary research is something that will emerge’ and that ‘it will not just be academic concept any longer’ with a greater community capacity to engage in research. However for one of the external stakeholders there was ‘nothing universal’ being applied to link across disciplines. There was ‘great linking up between the global climate modelling type people and water industry’ albeit in the areas of ‘science-based and reductionist science type of thing’. Another view existed on the ‘linkage back to things like policy or some of the social resilience’ as not quite as well integrated.

An important cultural dimension against all these comments on collaboration was the view that ‘the main thing that drives research is publications’. From this perspective there ‘isn’t any reward for a researcher to link up with other player in policy and community’. At the same time it was recognised that ‘linkages happen because of investments’. These views aligned with a concern about the internal performance management process in over determining research activity in areas of more open-ended multi-stakeholder and multidisciplinary activities. It seems that a lack of theory on multi-disciplinary collaborative modelling research activities limits the extent to which DPI can provide management support in this area. Such processes require support and facilitation of surfacing different conceptual models, methodologies and types of data that is not conducive to linear styles of management. This is one area in particular in which DPI research management activities could be supported with Systems approaches that embrace different ways of knowing about the world and facilitate ways of breaking conceptual barriers between different disciplines and interests. Furthermore engagement with communities could increase capacity for dialogue on climate change including local awareness and experiences of change to improve both research design and knowledge sharing. This would potentially increase an understanding and accommodation of difference between worldviews and traditions of knowing in farming communities and public research.

Another area of grounding research was in understanding biophysical interactions with the environment. This was an area in which researchers were asking new questions about plant-environment interactions or animal-environment interactions that increased sensitivity of agricultural performance in different climate systems. Against this perspective of localising understanding and integration of biophysical knowledge was reflection on the area of linkage in organisational structures to support integration across areas of discipline and practice. One of the limitations of modelling activities is the assumption that models provide ways of integrating information. Subsequently models that can recognise different data sets generate a simple view of integration as convergence. It seems that there is a contradiction here in recognising that information and knowledge sharing are different things. Knowledge as opposed to information sharing requires more open spaces for considering differences in interpretation. In this analysis participants used a range of different devices for interpreting CCA research. One of the internal stakeholders recognised research as ‘addressing the specific points of leakage of greenhouse gases’ for the purpose ‘modifying that production system to cope’. There was also a view of research in ‘understanding how crops grow in different environments’. Such interactions at the farm level were also recognised as activities
which ‘localise the thinking about the particular problem today’ in which understanding the interactions also ‘localise the responsibility’. However there was concern expressed here that research was ‘addressing subsets of the complete’ rather than opening up inquiry to ‘share it in ways that are going to be interpretable by different stakeholders’. As was noted by one of the research managers they were ‘continually pushing and cajoling’ to coerce people working on a collaborative project to ‘have a workshop’ as a means to ‘find that additional collective value’ that they bring to understanding ‘as a result of cross-disciplinary work’. This contrasted with the perspective of an internal stakeholder in which there was a ‘good degree of information sharing’ with a set of organised ‘forums within the department’. Further challenges in integration were realised ‘at a divisional level we know what we’re doing’ and yet the ‘further you move down the less related the components are’. Here a lot of energy was spent to ‘work very hard through the key project manager’ to try and bring all the threads together. It suggests and exemplifies how there are still constraints with ‘component thinking’ within the DPI organisation. Another manager saw the value of ‘commission work in systems science to enable workshops’ to open up discussion of issues and ‘explaining it in different ways’. Here the view was generated that ‘if you’ve got a good framework’ and ‘everybody can relate to that’ it can successfully eliminate a lot of ‘destructive competition and wasting of resources actually evaporate’. In reflection it was thought that the DPI ‘haven’t got the various wires’ or ‘best estimate’ on how all that knowledge can be drawn together. It was still seen as a ‘very conceptual, fuzzy model’. However from this perspective the management of research could be supported by ‘getting the right people together wit the right process’ and recognising the importance of ‘revisits in eighteen months time’ where ‘knowledge and understanding has advanced’. The complexity of the issues was still recognised as beyond conceptual research where ‘bringing that understanding together’ that has ‘so many interactions and feedbacks’ is something that was difficult get ‘on top of what the system looks like’. Insights from people with within and with interest in the organisation provides a useful device for opening discussion on ways of realising improvement and working towards a systemic and adaptive governance framework for CCA research. The organisation had been developing means to assist this through investment conferences and the management of projects through assessment groups and pre-schedule screening of proposals. This management layer was an important vehicle for project design and conceptual integration with policy goals. However a mixed reaction to this development was observed. Some felt that it constrained the possibility for collaboration and building research relationships beyond the DPI strategic industry relations. However there was also a view that is opened up awareness of other research activities within the organisation that could potentially lead to internal collaborations. It seems important that the question of managing capability through focus on disciplines rather than skills people need to collaborate or to conduct research within a particular problem framing was emphasised. This reflected the efforts of the organisation to better integrate its researchers with strategic goals and priorities but not paying enough attention to processes in realising collaborative capacity.

These developments are political in the sense of emergence of new political identities through recognition of relationships that might better support the transformation to a low carbon economy and society. The issues captured are political because they represent a form of reflexive decoupling from past relations in which an orientation to the future perceives an emergent instability in past patterns of development. It builds a view of sub-political activity in which new relations of self-to-other emerge out of interactions rather than existing social structures and sets of institutional rules. In this sense the development of instability and subsequent stabilisations through new relationships generate rule-altering activities against rule-forming activities in the mainstream of politics. In the context of this inquiry past patterns of development were framed by one of the stakeholders as having ‘been at war with nature’. An awareness of climate change provided an opportunity to realign activities in coordination with the non-human function
and sustainability of natural resources. The new alliances and new meanings and purposes defined in those alliances represent a ‘socially constructed’ future enabling capacity for action that traditional ties did not necessarily allow. In this sense participants’ framing of how research was grounded and linked-up is political as it represents new identities effecting relations of social and political interaction and emergent forms of power. Furthermore this makes stronger sense when research disciplines are seen as part of the political architecture, e.g., where the Economic and Social Research Council study into the politics of GM foods found that regulatory committees did not include ecologists (ESRC 1999: Wales and Mythen 2002), or in the context of DPI where FFSDRD underwent an internal political struggle to be seen as a new site for research economists. This is framed as political because it highlighted the question of what disciplines are seen as important, whose interests they serve and what entitlements other disciplines have to public service research. As an important example and lead on from this inquiry we ask the question of what types of research design would emerge if communities were to pose the questions of government CCA research rather than industries or resource managers on knowledge needs.

5.1.4 Conclusion
In reflection of these lines of inquiry the political situation is one which is evolving and dynamic for climate change research. One illustration of thus is the informal network alliances that are important sites for creative thinking and innovation. This was connected to conceptions that getting people together that didn’t usually meet, in novel forms of collaboration, was something that could only partially be planned for. Meanwhile experience initiated within the DPI showed that these encounters with a wider range of unlikely stakeholders produced positive results in problem focus and enthusiasm for action. However these experiences were not incorporated in a future plan for design and facilitation of new networks and opportunities for institutional and research innovation. The recognition of new relationships through research, as noted in the discussion on what research looked like on the ground, was producing new frontiers of knowledge with potential commercial and livelihood interest. This was in addition to the new relationships that were discussed in the communications and institutional focus of climate change, witnessed as a participant in DPI. It seems worth noting that recognising and facilitating new relationships was an important aspect of opportunities emerging in both biophysical and sociocultural dimension of research.

Furthermore connecting research across different disciplines was a new area of understanding with a growing demand of need across a range of complex biophysical and sociocultural issues often labelled as ‘wicked problems’. In this dimension there are useful tools and techniques from the portfolio of systems theory and practice that can assist in recognising the origins of difference in discipline theories and methods and how they might be accommodated. This aspects was being realised, at least in the biophysical sciences such as plant and livestock interactions and soil and water science, however there was less integration of biophysical sciences with sociocultural knowledge. The divide between social and natural systems was reinforced by the dominant framing of research as understanding biophysical interactions in environments specially focused on the area of production and resources use efficiencies at the farm level. However it was also being used as a more generic means of planning and development of future regional landscapes by better understanding what kinds of commodities were suited to existing and changing regional climates. Understanding institutional arrangements at the regional level was producing new possible frameworks for socioeconomic development. However the organisational structure to support integration of research across disciplines, particularly across biophysical and sociocultural was noted to be lacking. The extent to which current organisational structures and cultures contribute to supporting more open inquiry processes in which innovation can be realised is limited.
5.2 Summing up: Constraints and possibility

The implications of participants’ perspectives on what might be possible for future capacity and development of CCA research reflects an area of possibility that exists for facilitating dialogue and exchange of ideas as a routine practice for research management. Participants’ experiences have demonstrated that new connections are realised through novel interactions. Spaces in research and research management practice could be opened up to provide for emergence and enable the conditions for innovation. Participants’ accounts offered examples of the importance of removing impediments to adaptation, however, which also required an ability to recognise where adaptation was occurring. The descriptions offered were not sufficient to be able to clearly identify what adaptation looked like. Nevertheless some offered the view of linking long and short term actions to the understanding of effective adaptation. In this discussion it was recognised that integrating responsibility as building understanding together through interactions between researchers and research users could support confidence in taking action under conditions of uncertainty.

For stakeholders uncertainty was seen as an opportunity for realising new pathways for development. It represented a loss of past stabilities and confidence in traditions. Emphasis was placed on the importance of human imagination and social engagement to make collective choices by reconciling tensions and building consensus in the process of interaction. In this sense consensus is not an object but an outcome that is stabilised in relations of agreement. If relations change so does the possibility of consensus. Dialogue is enabled to support understanding together and raise appropriate research questions. If the basis is linear and rationalised on past stability there is not enough awareness of dynamic and changing environments. This perspective from participants contradicts the framing of strategy documents in which action is based on a stable past not yet fully understanding the turbulence. In other words the documents recognise environments of turbulence; however the skills and capabilities are shaped in the strengths of traditional models of linear thinking.

It was clear from participants’ perspectives that there were different types of stakeholder with different types of knowledge need. It was not apparent from reading the strategy documents that this was the field that DPI was working within. It was also apparent that this represented a shift from the tradition of working with industry stakeholders largely represented by peak industry bodies. With the issue of climate change DPI was not just addressing knowledge needs of industry but also of other stakeholders in government including policy and a variety of other governing bodies, regional, industry and research communities. Greater diversity of stakeholding and collaboration required a set of approaches and skills that seemed to be emerging in management practices but not yet recognised as important to the organisational structure and management of CCA research. Managers were working across diversity with new realisation of difference and integration of stakeholding and collaboration. Value can be added to the organisational strength of these activities by developing new capability in the understanding and practice of communication as recursive.

Working across diversity of disciplines and knowledge needs can be supported by realising how they are socially constructed and positioned within society. However this means breaking with traditional styles of research management. Multi stakeholding and multidisciplinary research is not conducive to linear management styles that hold clearly defined boundaries and criteria for performance and research direction. Different disciplines and interests do not necessarily fit neatly into each other and often realise conflicts when they try and work together. They have different histories and different problem construction, leading to different types of solutions. Conceptual integration means more than just ‘fitting together’. It requires method and purpose for realising and accommodating difference. CCA research management practice can benefit from
understanding how disciplines can, at times, contradict each other and where they can gain fruitful insight by opening up to other ways of problem framing. The same goes for different interests in CCA research stakeholding.

In complex issues like climate change there is a need for multidisciplinary advice and action but traditions and cultures of practice can constrain realisation of this. Anxieties about speaking with confidence, from the perspective of scientific disciplines and in terms of probabilities or most likely causes and effects, has the tendency to hide uncertainty rather than bring it the surface in communicating with non scientific communities. Confronting uncertainty can open up research framing to new types of question. It is evident within DPI that there is only partial realisation of opening up research framing. From a management perspective the organisation is still engaging with CCA research practice as a means to test validity, which is appropriate for clearly definable cause and effect. However it is not enabling innovation in a cultural sense. On the other hand stakeholders realised the more dynamic context of change as controlled by externalities. This more dynamic environment of change was recognised in climates and markets as requiring a governing response that was not in control of the situation but had to respond or react to dynamic conditions of emergence.

There are limits within DPI in acknowledging uncertainty and complexity. The tendency to reduce complexity often happens too hastily without a deeper appreciation for how complexity emerges. In scientific terms complexity is the patterned and non patterned emergence of multiple causes and effects. It can result in the appearance of linearity which may otherwise be the effect of stable interactions amongst multiple causes and effects that once disturbed can produce a less stable state or transformation. However rather than a hasty reduction of complexity, uncertainty can be seen as an important device for recognising emergence or the appearance of unexpected patterns that can give rise to a new state of stability or understanding. Uncertainty can also lead to new ways of thinking about and conceptualising complex problems requiring new types of solution or approaches to their management. This is not pure abstraction of patterns into underlying causal models but abstraction for the purpose of action.

Adapting to climate change was framed as ‘step change’ or transformation to realise a new system in farm operation. It was recognised by DPI participants that this was a fundamental transformation that required more than new technological devices to improve the system performance. However it seemed that research management practice was locked in the mode of seeing new farming technologies to help people adapt in the short term without the means for reconciling the longer term vision of farming systems to support sustainable livelihoods. Some tensions emerged in participants descriptions of short term adjustments that may lead to maladaptive changes over the longer term. One of the significant areas in this was responding to climate changes that led to increases in greenhouse gas emissions. However it was recognised that small changes in the system had to be reconciled with their ‘upstream’ and ‘downstream’ effects. Thus there was a perceived need and responsibility to act beyond the technological solution amongst research managers. These are important discourses that demonstrate the articulation of strategy documents actions, however in a way that confronts the issue of how practice can provide some strategic lessons in implementation.

Against the certainties and stabilities of past research performance in improved productivity and publication rates there is a need for better techniques for understanding and managing uncertainty and risk as emergent properties of complex interactions. To become more open to and realise emergence and the opportunities for new kinds of stability against a more dynamic global market and climate there is need to focus on knowledge resources as interpretive capabilities and not just information flows. Innovation
derives from knowledge exchange and learning between entities (Nooteboom 2000) as well as arising in capabilities to overcome constraints. Climate change and the constraints of uncertainty represent an opportunity to do things differently in an experimental mode of learning from doing. The limitations of traditional modes of development have been recognised as unsustainable under conditions of climate change and through changing social and environmental values. This situation represents an opportunity for DPI to develop its organisational intelligence and learning capability to realise internal and external operating systems and their adaptability to dynamic climate and market environments. The future capability CCA research can benefit from DPI refinement of core competencies in social learning and to develop itself as a learning organisation in which understanding emerges through interaction.
Chapter 6 Appreciating initial starting conditions 3:  
scoping purposeful design for creating a Systems  
community of practice

6.1 Creating communities of practice: scoping purposeful design

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(paper in press, Journal of Knowledge Management)

Abstract
Purpose - To scope the nature and form of practices, understandings and institutional arrangements that might contribute to the successful ‘design’ and continuity of Communities of Practice (CoP) in a state government department in Australia. The study aimed to provide research evidence to support the design and establishment of a CoP based on systems thinking within this department.

Design/methodology/approach – Thirteen semi-structured interviews were undertaken involving fourteen informants. The interviewer also attended one CoP meeting. An emergent approach to research design was adopted with data analysis guided by previous studies on CoPs.

Findings – The research revealed the existence of six CoPs that were purposefully created internally by the department. Six ‘design’ and practice considerations were suggested for practitioners aiming to create and sustain successful CoPs.

Research limitations/implications – Interview material was the only source of primary data and it was gathered from one organisation only – a state government department in Australia. Findings indicate the role of the CoP coordinator is still not fully understood.

Practical implications – The results from this study can be used in re-designing a systems thinking CoP to support systems thinking within the department. The study also revealed that purposefully designing CoPs is possible and useful for practitioners aiming to collaborate and share expertise across disciplinary and divisional boundaries.

Originality/value – This study provides some guidance for the purposeful design of CoPs, which has been under-examined in the literature.

Keywords Communities of practice; Systems practice; CoP coordinator; Purposeful design.

Paper type Research paper

6.1.1 Introduction
Communities of practice (CoP) have been described by du Plessis (2008) as one of the most significant means of fostering knowledge management in the twenty-first century. Moreover, Fontaine and Millen (2004) found that CoPs can considerably enhance the exchange of expertise, information, collaboration and resources within organisations. Wenger and Snyder (2000) listed six ways CoPs can improve organisations – through rapid problem solving, professional skill development, best practice promotion, retaining talent and by guiding strategy. Since the nineties awareness in both academia and the corporate sector of the value of communities of practice has increased. During the past decade in particular, there has been a substantial increase in the number of publications on communities of practice (Amin and Roberts, 2008). The appeal of CoPs is such that they have been assessed for their utility in a diverse range of contexts, for instance, in nursing (Andrew et al., 2008), at Rolls-Royce (Meeuwesen and Berends, 2007), for school leaders in Singapore (Hung et al., 2005), in the Norwegian electronics industry (Gausdal, 2008), in the Dutch police force (de Laat and Boer, 2004), among many others.

Defining a community of practice is a precarious exercise as the ambiguity of the term has meant that various definitions of CoPs can be found throughout the literature. Furthermore, the definition has changed over time (Duguid, 2008a). According to Andrew et al. (2009), it was Lave and Wenger (1991) who provided the original explanation of a CoP. They described it as a style of learning that incorporates components of active
participation, identity and situation. Wenger’s (1998) commonly cited definition describes three characteristics central to the existence of CoPs – mutual engagement in a shared practice, the creation of a common repertoire, and the negotiation of a joint enterprise.

Despite a growing interest in CoPs, it is still not apparent to what extent a CoP can be created purposefully through ‘design’ whether from scratch or through harnessing nascent CoPs. Meeuwesen and Berends (2007) described four CoPs that were intentionally created in the manufacturing division of Rolls Royce, yet they contend it was unknown if they were going to progress beyond the establishment phase. McDermott (2003) provided eight suggestions for sustaining management-created CoPs, but it remains unclear how these suggestions could be used to establish new CoPs or invigorate latent ones. Hart and Wolff’s (2006) study on community-university partnerships reported that a CoP had started to form between academics and community members after the two groups had collaborated on a book-writing project. But it was unclear if formation of the CoP was deliberate. Smith and McKeen (2003), building upon the work of Wenger and Snyder (2000), claimed there were three general areas in which organisations can provide support to CoPs – technical infrastructure, management, and culture. But it is uncertain how these areas, particularly the latter two, could be reconfigured to be more supportive of CoPs. As Coakes and Clarke (2006) assert, there is little agreement on how organisations can purposefully design CoPs. This paper goes some way towards addressing the question of purposeful design as it aimed to understand the factors constraining and enabling the implementation of a specific type of CoP – one based upon systems science - within an Australian state government department (called here the Department of Land Resources, or DLR, a pseudonym). The purpose of this study was to understand the nature and use of named, and thus purposefully generated, CoPs within the DLR and the public sector more generally. This research expands knowledge in two areas, namely - how to purposefully create CoPs and how the CoP concept has been taken up in the public sector.

This scoping research also contributes to a broader research agenda concerned with the conduct of climate change adaptation research and the contribution that systems thinking and practice might make to climate change research praxis. As climate change has been considered a ‘wicked problem’ (Battie, 2008), which is a problem that is “multifactorial, dynamic in nature, and resistant to resolution” (Caron and Serrell, 2009, p. 195), it can be argued that climate change adaptation necessitates at minimum, a transdisciplinary research approach. A community of practice, with its emphasis on collaboration and knowledge exchange, could thus provide a forum for DLR employees to foster the transdisciplinary approaches of systems science to overcome the compartmentalisation of expertise within disciplinary and divisional boundaries (the so-called silo effect), and help the DLR in its aim of effecting future climate change adaptation.

This study begins with some theoretical considerations particularly CoPs theory in relation to Systems theory that in part shapes the research. The authors then describe the research setting and explain the impetus for this research. The methods employed in gathering data are then discussed, followed by a review of six CoPs found to be in existence within the DLR. Factors explaining the success of particular CoPs are then highlighted and implications for the purposeful design of CoPs, particularly one based upon Systems Science, are discussed. Finally, this study suggests areas for future CoP research.

(i) Theoretical considerations

CoPs theory can be considered as an emerging theoretical tradition within its own right. A key distinction is that CoPs theory is built on a social theory of learning rather than theories of individual or social learning (see Blackmore 2010). CoPs researchers have
made links to other theoretical traditions, as for example to actor-network theory (Fox, 2000), exemplifying the synergies that may arise from exploring theoretical intersections. An in–depth review of CoPs theory is not provided as others have done that (Blackmore 2010). But because this study contributes to developing design and practice considerations for establishing a CoP within the DLR based on systems science it is appropriate to explore what links exist between CoPs theory and Systems theory. The authors regard Systems as a transdisciplinary field of inquiry dealing with practical holism through concepts such as boundaries, wholes and emergent properties, instead of the isolation of separate parts typical of reductionism and linear cause and effect thinking (Schlindwein and Ison, 2004; Ison, 2010).

Wenger (2010b) argues there are significant parallels between the discipline of Systems and the concept of CoPs, and points out that CoPs are the most basic social units that have the qualities of social learning systems. Moreover, like systems, CoPs are self-organising, they have emergent structures, they are characterised by multiple and diverse relationships and have fluid boundaries (Wenger, 2010b). The connections between CoPs and the discipline of Systems have also been drawn upon by Snyder and Wenger (2010). They used learning concepts within the systems discipline, such as action learning, cross boundary representation and cross level connections in their advocacy of a "world learning system" (p. 125) designed to manage complex, interconnected global problems such as hunger, poverty and overpopulation. Creating such a learning system would require supporting self-organising groups of practitioners from many disciplines located in various locations around the world – a community of practice (Snyder and Wenger, 2010). Therefore, following Ison (2010), the conceptual tools provided by systems thinking have the potential to help the DLR build the systemic and adaptive learning culture required for addressing climate change adaptation as well as other innovation strategies.

As Systems is still a niche area within the DLR, a systems thinking CoP could help raise the profile of Systems within the department and give systems practitioners a space to develop their repertoire of systems techniques. Systems could also add to the knowledge and expertise available to the DLR as the discipline brings forth particular traditions of understanding not used by people with other methodological backgrounds. For instance, the suite of systems diagramming techniques, including multiple cause diagrams, influence diagrams, systems maps and rich pictures, are used by systems practitioners to engage with and understand complex situations (Ison, 2008). Systems techniques can help in the DLR’s goal of climate change adaptation research as such techniques can reveal previously obscured relationships between elements, positive and negative feedback mechanisms, systemic complexity and the mental models and metaphors used by people in understanding and communicating the situations they are investigating (Ison, 2008).

The main purpose of the Systems CoP is to develop the systemic competencies of its members. This is not easy, because such a development would require a shift in the worldviews of community members to view situations systemically and to start acting in systemic ways (Bawden, 2010). Challenging also are attempts to make systemic changes to situations, as Bawden (2010) would argue that the people attempting such changes would themselves require a change in their worldviews.

6.1.2 Research Setting
The DLR is a large organisation that encompasses several different divisions, and its employees are from a wide variety of disciplines. The organisation’s structure, as conveyed in its organisational diagram (see Figures 1 and 2), replicates many hierarchical organisational models. The DLR employs approximately 2,500 people in 76
locations across the state, including thirty major offices. It is led by a Secretary supported by an Executive Committee who answer to two Ministers within the State Government. The Executive Committee consists of an Associate Deputy Secretary and four Deputy Secretaries. Each deputy is responsible for one of the five Groups that make up the DLR. All levels below the deputies in Figure 6.1 are equal. An executive director in Figure 6.1 is in bold font to highlight the link between the two figures. This executive director leads the division represented in Figure 6.2. An individual at a level equivalent to research manager (see Figure 6.2) was where the initiatives for CoPs and systems thinking arose within the DLR.

Fairtlough (2007) argues that a hierarchical structure can slow the learning process, as learning in hierarchies typically takes place only at the top, while the mid to lower level constituents are forced to follow orders. But no organisation can survive without learning except during highly stable organisational conditions (Fairtlough, 2007). As the DLR is one of the major state government organisations in Australia responsible for helping farmers, landholders and agriculturalists across its state adapt to climate change, it is itself undergoing a period of change as it must acquire and share new skills to manage the numerous environmental, social, economic and political (among other) consequences of such climatic alterations. Since the hierarchal configuration of the DLR will remain in place, the organisation must find ways to further learning processes within the current organisational structure. Moreover, when those at the top of an organisational hierarchy are made aware of newly created knowledge, the speed with which it is distributed throughout an organisation is increased (Nonaka, 1994). As communities of practice are known to promote intra-organisational proficiency and enable knowledge and expertise to be shared across large organisations (Wenger et al., 2002; Probst and Borzillo, 2008), they offer a way to enhance learning within the DLR.

DLR has had a history of creating, and to some extent supporting, CoPs. However CoPs have not received organisation-wide support. The impetus for this study came when those responsible for the Systems initiative wanted to use DLR’s history of ‘creating’ CoPs as a means to aid embedding systems science capability. Consistent with other initiatives within DLR in the period 2006 to 2010, those championing the ST capability-building programme set out to launch a ‘Systems CoP’.

As there was little extant understanding within DLR of how CoPs can be designed and managed to help the organisation develop and promote climate change adaptation strategies, and because what might constitute a ‘Systems CoP’ was unclear, this scoping research was initiated. The research sought to understand how communities of practice, as a purposeful approach to capability building and practice change, are understood, managed and developed within the DLR. It was conducted specifically so as to inform and design better strategies for supporting capability building in systems thinking and practice, including strengthening the strategic capability of DLR to deal with climate change adaptation. While systems approaches can take many forms, CoPs were chosen because it is claimed they help overcome barriers to learning created by hierarchies and organisational silos. It is also argued that they do this by fostering collaboration and a multidisciplinary approach, both of which are necessary for the DLR in helping its constituency adapt to the imperatives of climate change.

So what is a successful or thriving CoP? In the business management literature, a successful CoP is generally one which helps businesses compete in the marketplace. The value of a CoP is then based on its ability to help the organisation it exists within achieve the organisation’s goals (Wenger and Snyder, 2000; Wenger et al., 2002; McDermott, 2003; McDermott, 2004). As many organisations view knowledge as their key to success, a successful CoP is one that enables knowledge to be developed, deployed and shared throughout an organisation (Wenger et al., 2002). Moreover, an innovative
organisation is one that is able to distribute and embody the knowledge it creates (Nonaka and Takeuchi, 1995) and one of the ways organisations can foster innovation is via CoPs (Saint-Onge and Wallace, 2003; Brown and Duguid, 1991).

As the DLR has numerous goals, this definition is too broad for current purposes so specific aspects of each CoP will also be considered. The authors regard a successful CoP to be one whose members: (1) demonstrated a sense of stakeholding or ownership of their CoP topic; (2) demonstrated a willingness to participate in meetings and to collaborate and share expertise; (3) communicate, collaborate and share expertise outside of meetings, and (4) identified gaps in their knowledge and attempted to fill those gaps by, for example, suggesting new topics for meetings. Ison and Russell (2000) describe enthusiasm as a desire to engage with practices that draw upon the energy, imagination and ideas of an individual or group. Enthusiasm is a useful concept for this study as it helps to explain the reasons behind the success or failure of CoPs in the DLR.

6.1.3 Methods

Four DLR research scientists held a workshop with the authors of this study where key people involved with CoPs within the organisation were identified. Fourteen individuals were named as potential interviewees. Contact details of these individuals were provided by one of the research scientists, and a group email was sent to them introducing the researchers, outlining the project, and inviting them each to participate in a thirty minute one-on-one interview. Those interviewed for this study were all DLR employees.

According to Dunn (2005) interviews are a valuable way of revealing information about experiences, events and opinions. Information of this type does not usually exist in written form. In the DLR, much of the knowledge of CoPs existed in tacit rather than in written form (for a notable exception, see Fenton 2008), moreover communication of tacit knowledge is one of the strengths of CoPs (Zappavigna, 2006; Duguid, 2008b). Interviews were therefore an appropriate method of data collection.

Semi-structured interviews were undertaken to promote a conversational interview style as this gave the interviewees space to build their ideas and express them succinctly. It also allowed the interviewer to ask questions in a manner and in an order that was applicable to each participant. As Corbetta (2003) explains, semi-structured interviews allow the researcher flexibility to adapt the form of questioning to each interview situation while ensuring all of the themes are dealt with sufficiently. The freedom to alter the phrasing and order of the questions based on the circumstances of each interview was advantageous as interviews took several forms (face-to-face, face-to-face with two informants, telephone interviews), which necessitated variations in questioning style. The order of questions was also varied as appropriate to maintain conversational flow.

Interviews were conducted between September and October 2009. The interviewer encouraged interviewees to discuss their experiences of CoPs informed by questions formulated from a review of the academic literature and key informant advice, which assisted in question selection and phrasing. Questions were typically answered in approximately thirty minutes. The interview schedule, as Dunn (2005) explained, is used to improve consistency in questioning and enable comparisons of responses. All interviews began with the same question – “could you explain your role in the organisation?” General questions were then asked about the history of CoPs within the department in combination with more specific inquiries that aimed to build up an understanding of the nature of each CoP within the DLR. Participants were asked about the regularity of meetings, the purpose of their CoP and whether or not they believed it was successful (and why). They were also asked how high-level management, and the department in general, perceives CoPs. As this study aimed to provide guidelines for
establishing a Systems CoP, questions were geared towards surfacing factors that constrain and enable the establishment of CoPs within the DLR.

Interviews were recorded with the permission of the interviewees. A total of fourteen people were interviewed, twelve one-on-one interviews, six telephone interviews and six face-to-face (one of these interviews involved two informants). The sample size was considered appropriate for this scoping research, although results would not be representative for such a large organisation. But as Gobo (2004) would argue, while the findings were not statistically representative they were still socially meaningful, and thus useful. Following Ison and Watson (2007), data was analysed using an inductive approach that drew upon the techniques associated with grounded theory as formulated by Glaser and Strauss (1967). Data was worked through systematically and coded for the purposes of organisation and analysis. Key themes to emerge were noted and the data was categorised based on these themes. Codes assigned were both descriptive and analytic. Interviewees were also coded (I1 – I14), and will be cited as such. One CoP meeting was also attended, data from which is cited as DLCoP Meeting 8, 2009. Themes that emerged from the meeting were coded in the same way as interview material.

Figure 1. “DLR” departmental structure as revealed through current organisational diagram; the executive director in bold font indicates the division shown in the proceeding figure.

Figure 6.1 ‘DLR’ department structure as revealed through current organisational diagram
Consistent with its role as scoping research designed to elucidate design possibilities for a Systems CoP in the DLR, preliminary outcomes in the form of a draft paper were used to mediate understandings and practices amongst those interviewed (all interviewees availed themselves of the invitation to comment on the draft and their feedback has been incorporated in this paper in a second cycle of data gathering). In doing this the authors were conscious that the draft could mediate changes in understandings and practices of those involved (Steyaert and Jiggins, 2007) as well as model a second-order learning system. A second-order learning system operates when there is conscious learning about learning (Ison, 2010). Consistent with the interpretive epistemology that underpins this research assertions of interviewees through triangulation with other data sources have not been sought. For this reason the paper does not claim to provide a definitive guide for the establishment of CoPs, rather it elucidates design considerations that may be pursued by others in context sensitive ways.

6.1.4. Findings
There are currently six functioning entities described as CoPs within the DLR (see Table 6.1 for details) and they have experienced varying levels of success. These are the Market Mechanisms CoP (MMCoP), the Climate Community of Practice (CCoP), Evaluation CoP (ECoP), Social Context Network (SCN), the Development and Learning Community of Practice (DLCoP) and the Systems Community of Practice (SCoP). All of these CoPs were purposefully created by DLR employees. The idea was for higher management levels of the DLR to support the establishment of CoPs provided the goal of the CoP was aligned with the goals of the DLR (I9). A full-time CoP project coordinator was assigned responsibility for the establishment of CoPs. Section 4.1 reviews the processes of CoP establishment; in section 4.2 each CoP is catalogued and assigned a status (‘successful’ or ‘struggling’) based on the definition of success as explained in section 2.

The role of coordinator was found to be critical for the success of CoPs in the DLR because formal CoPs carry a significant organisational and administrative load. Coordinators are thus key players in the life of CoPs within DLR and must tread a fine
line between fostering self-organisation and ‘taking control’ (I1, I3, I6, I5, I7, I9). Their tasks include updating mailing lists, organising meetings and training days, acting as the contact for members suggesting discussion topics, communicating relevant issues to the group and encouraging participation in meetings (I1, I3, I5, I6, I7).

(i) Overview of CoPs in DLR

CoPs are ongoing within the DLR. The first community to form was the Evaluation Community of Interest (ECoI) (I10). While a Col rather than a CoP, it provided the initial impetus for the establishment of CoPs in the DLR (I7, I9). The ECoI was formed in 1999 by DLR employees who had contact with evaluators from other state departments (I5). The ECoI was created from this network after the DLR employees were given formal work time to pursue inter-departmental information sharing and networking (I5, I7). The main difference between a Col and a CoP was that the former is constituted by people with an interest in the topic while the latter is comprised of practitioners of the topic (I1, I5, I6). Similarly, Wenger et al. (2002) believed a shared interest alone is not enough to constitute a community of practice, that there needs to be, at a bare minimum, some degree of shared practice between members before it can be said that a CoP has been enacted.

Aside from the six CoPs that were identified there are also informal CoPs and Cols in existence within the DLR but they were not the subject of analysis. These communities emerged spontaneously without an official establishment process and without nominated coordinators.

The ECoI remains in existence and currently meets four times a year (I5). Membership to the ECoI is open to all employees working at state government departments, while membership to the ECoP is limited to DLR employees (I5, I7). With two hundred members, the ECoI is much larger than the ECoP, and with more members there are more topics to be discussed during meetings, however this limits the extent to which these topics can be explored (I5, I7). The ECoP, with only twenty-four members, discusses fewer topics in much greater detail (I5, I7).

The Social Context Network (SCN) was the first CoP to be established beginning about five years ago when an individual at a level equivalent to research manager (Figure 6.2) wanted to learn more about the “people side of the project” (I6, I8). Some meetings were held and from them the SCN was created (I6, I8). Further CoPs developed because one of the divisions of the DLR was interested in fostering organisational learning (I9). Various forms were considered but those responsible decided on CoPs based on the successes of the SCN and the ECoI (I9), and these were used to guide the processes of establishment.

The role of CoPs in DLR has grown organically. An individual who was a social researcher with an interest in CoPs (I7) having done in-depth work on CoPs was sponsored by the DLR to formalise the concept within the department (I7, I9). Each CoP began with an establishment workshop organised by this person, who also acted as the CoP project coordinator during this early stage (I1, I6, I7, I9). The establishment workshops provided a forum to explain the concept of CoPs (I6, I8), and to decide upon the regularity of meetings, the name for each CoP and who would coordinate, sponsor and chair these CoPs (I1). The project coordinator gave speeches to potential CoP members, sent invitations to attend establishment workshops, informed people about the nature of CoPs and conducted other administrative tasks (I1, I9). She helped establish five CoPs with the DLR – the SCoP, ECoP, MMCoP, DLCoP and the CCoP (I1, I2, I9). Almost all interviewees considered this person to have provided the original impetus for the establishment of CoPs in the DLR (I1, I2, I3, I4, I5, I6, I7, I8, I9, I11, I12, I14). While
she no longer works for the DLR (I1) her role is now partly covered by another person who does CoP project coordination in addition to other duties (I9).

It was believed that CoPs would be self-sustaining after establishment, as the members would be engaged and consistently participating (I9). This has occurred to some extent, but results are mixed. The departure from the DLR and the absence of a full-time replacement of the ‘in-house champion’ seemingly represents a loss of a significant source of knowledge and enthusiasm for CoPs.

(ii) Status of current CoPs in DLR

MMCoP
This CoP arose in 2007 out of a need to educate practitioners about market-based mechanisms (I14). The status of the MMCoP is described as struggling because it lacks every parameter of success (as defined). Moreover, according to the sponsor it has “almost folded” (I14). Members lack a sense of ownership and only about 15-20 people show up to meetings despite the mailing list having 80-100 people on it (I14). As there seemed to be a lack of communication between members in general (I14), there is unlikely to be collaboration or sharing of expertise outside of meetings, nor identification of knowledge gaps. Status: struggling.

Table 6.1 An overview of communities of practice within the DLR

<table>
<thead>
<tr>
<th>CoP</th>
<th>Age</th>
<th>Purpose</th>
<th>Numbers</th>
<th>Development Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation Community of Practice (ECoP)</td>
<td>2 years (ECOI is 10 years old)</td>
<td>Evaluation training, networking, support</td>
<td>24 (ECOI has 200)</td>
<td>Established</td>
</tr>
<tr>
<td>Climate Community of Practice (CCoP)</td>
<td>2 years</td>
<td>Space for DLR staff to discuss CC issues</td>
<td>330</td>
<td>Established</td>
</tr>
<tr>
<td>Development and Learning Community of Practice (DLCoP)</td>
<td>3 years</td>
<td>Collaborate with different divisions of DLR on L&amp;D.</td>
<td>50</td>
<td>Established</td>
</tr>
<tr>
<td>Systems Community of Practice (SCoP)</td>
<td>3 years</td>
<td>Advance systems thinking within department</td>
<td>20</td>
<td>Struggling</td>
</tr>
<tr>
<td>Market Mechanisms Community of Practice (MMCoP)</td>
<td>2 years</td>
<td>Inform people about market-based mechanisms, evaluate their effectiveness compared to other policy mechanisms.</td>
<td>80-100</td>
<td>Struggling</td>
</tr>
<tr>
<td>Social Context Network (SCN)</td>
<td>5 years</td>
<td>Increase awareness of social research</td>
<td>67</td>
<td>Struggling</td>
</tr>
</tbody>
</table>
SCN
It was the first CoP in the DLR and it was established in 2004, before the department formally tried to foster CoPs (I6, I9). It is unclear if the DLR referred to the SCN as a community of practice during this period. Its aim was to raise awareness of social research issues (I6, I8). This CoP struggled for several reasons. Firstly, it lacked a clear purpose (I8) which is suggestive of a general lack of ownership, communication and the sharing of expertise. Secondly, it had two or three different coordinators throughout its life (I8). This lack of leadership appeared to have stalled participation in meetings and the sharing of expertise in general. Thirdly, it formerly had a longwinded title which could have alienated people, making it difficult for them to identify with the CoP. This could have contributed to a lack of participation. Fourthly, its membership was inconsistent, as each meeting involved different people in attendance (I8). This was another issue of participation. Fifthly, members had a variety of responsibilities. When they carried out their roles external to social research, their interest in the SCN waned (I8). Collaboration therefore becomes difficult when members must regularly attend to matters unrelated to social research. Status: struggling.

ECoP
ECoP members were highly enthusiastic, with their meetings incorporating time for conversations in which “free flowing debate, discussions, disagreements are welcomed and encouraged” (I7). This indicates a high level of participation in meetings, collaboration and sharing of expertise. There is also a lot of communication between community members outside of meetings due to the nature of evaluation (I7, I5). As there are typically only one or two evaluators per team, evaluators frequently rely on one another for advice, necessitating communication outside of meetings (I7, I5). A listserver was also used to communicate outside of meeting times (I5, I13). Furthermore, the small number of evaluators per team creates a need for a CoP (I7, I5) as members appreciate the value of participation, collaboration and sharing of expertise – activities they cannot do effectively within their own teams due to the lack of fellow evaluators. Evaluators can also experience pressure when conducting sensitive evaluations, creating further need to share expertise. Status: established.

CCoP
As climate change issues are the responsibility of many employees across different areas of the DLR, the CCoP began as a way to foster collaboration across divisional boundaries (I1). As a result the CCoP currently incorporates people from a variety of disciplines. Five events are held each year involving presentations by guest speakers and the showcasing of current projects (I1, I11). According to both the CCoP coordinator and chair, there is generally a high rate of attendance at meetings (I1, I11). This suggests a desire amongst members to collaborate and share expertise, indicative of a successful CoP. Status: established.

DLCoP
Development and learning is practised by many divisions across the state so the DLCoP was established in 2006 to provide a forum for these divisions to collaborate (I3, I4). The DLCoP has a meeting every four months and it has approximately fifty members (I3, I4). Members were aware they needed to communicate outside of meetings if their CoP was to be successful (DLCoP Meeting 8, 2009) which demonstrates the importance of the DLCoP to its members. Status: established.

SCoP
In 2006 those responsible for championing ST within the DLR followed the emerging practice for establishing CoPs within DLR. However it soon became clear that ‘established practice’ combined with the departure and the lack of a full-time replacement of the overall coordinator, meant that the new CoP was unlikely to succeed. This situation created an impetus for this research which revealed that the SCoP had not yet progressed past the establishment workshop (I2, I12). Some seminars were held (I10, I12) but it would seem they failed to foster enthusiasm. An online forum was created but it remained highly under-utilised (I12). A systems training course was also organised and a systems expert visited in early 2009 (I10, I12) but in the absence of an active CoP this failed to foster enthusiasm that was apparent in an organised way. The incipient SCoP struggled from a lack of coordination, as the coordinator had too many other responsibilities to deal with (I2). This CoP used the same establishment techniques as other successful CoPs within the DLR and its members were, at least initially, enthusiastic about systems (I2, I10, I12). However, it has struggled due to unclear objectives (I12), lack of collaboration created by unresolved disagreements over the type of systems expertise to be shared (I10), and a lack of communication and stakeholing during the establishment phase (I10). Status: struggling.

In summary, the DLR has been successful in purposefully designing some CoPs. This was achieved without external assistance. The most successful CoPs in the DLR are the CCoP, ECoP and the DLCoP. The ones which are struggling are the SCN, the MMCOP and the SCoP.

6.1.5 Discussion and implications
The DLR is in many ways at the forefront of public sector innovation in pursuing the purposeful creation of CoPs. Despite being a highly structured and hierarchical organisation, the DLR still has space for some self-organizing, responsible autonomy (Fairtlough, 2007), evidenced by the successful functioning of several CoPs. Yet the organisational and institutional context of the DLR is such that CoPs (with some exceptions) appear largely unknown to management at the higher levels. The organisation therefore lacks the ability to formally assess the value of its CoPs, which has implications for on-going purposeful design. Without higher management recognition, CoPs are vulnerable to structural, institutional or other changes coming from the upper levels of an organisation’s hierarchy. It also makes the allocation of work time towards CoPs difficult to justify.

The findings of this study have implications more generally for the purposeful creation of CoPs. The articulation of purpose and agreement among key stakeholders, followed by the conceptual modelling of activities required to achieve a transformation, or transformations (what a system does), is central to most lineages of systems thinking and practice. This process entails making boundary judgements about a system of interest (Ison, 2010). From this perspective the failing CoPs suffer from a crisis of purpose, inappropriate boundary judgements and thus inappropriate activities needed to effect transformations in relation to purpose. Ironically this seems to have been the case for the incipient Systems CoP. Confusion about purpose seemingly led to SCN’s system of interest being too broad, as its boundary was cast too wide.

Reaching agreement about purpose can be a process for significant learning. Wenger (2010a) argued that disputes over boundaries can result in mutual learning. For example, evaluation practitioners saw disagreements as a way to enhance learning, thus the ECoP was functioning efficiently as a learning system. Wenger (2010a) argued that for learning to take place at boundaries within learning systems, there needs to be a balance between competence and experience amongst members. This balance was evidenced amongst the successful CoPs. The CCoP, for example, had variable topic areas that encouraged
the exchange of different repertoires, allowing members with different competencies and experiences to interact (Wenger, 2010a). Disagreements were welcomed, even encouraged within the ECoP (I7), permitting an "open engagement with real differences as well as common ground" (Wenger, 2010a, p. 146) that helped encourage learning. The active members within the DLCoP were open about the shortcomings of their CoP, such as the lack of participation in meetings and a lack of communication between meetings (DLCoP Meeting 8, 2009). Following Wenger (2010a), this is suggestive of an ability amongst DLCoP practitioners to honestly assess the competence of their community.

Within the SCoP, the debate amongst two subgroups within the SCoP over whether the focus of the community should be on systems theory or systems practice was born out of the diverging worldviews between these two community subgroups. One of the ways systems thinkers develop systemic competencies is through developing learning systems designed to challenge their own epistemes, or worldviews (Bawden, 2010). Unfortunately, what was an opportunity for mutual epistemic development ended in a stalemate, with the SCoP struggling as a result. The authors are of the view that both systems theory and practice are important for developing systemic competencies and thus would urge SCoP members to gain an appreciation for both theory and practice within systems in order to advance the SCoP from struggling to successful.

By understanding the CoPs within the DLR practitioners can acquire suggestions for the successful creation of their own CoPs and of potential hazards to avoid. The rigour of these suggestions is enhanced by the fact they were drawn from real-life examples of CoPs within a public-sector organisation in Australia. More generally, this study showed that the role of coordinator is not well understood and needs further investigation. There are however theoretical caveats that need to be raised. These relate to the conceptual and praxis boundaries between a CoP and CoI and the relevance of these distinctions in public sector organisations.

As this was scoping research a limitation is that participant observation and longer-term ethnographic research have yet to be conducted to elucidate the veracity of claims and the nature of the interactions within the different CoPs. Moreover, the DLR appears to lack feedback mechanisms required to assess the organisational learning occurring due to CoPs. This could potentially be a responsibility of the Human Resources (HR) division. However, due to the exploratory nature of this study, it is unknown whether the HR division has the capacity to take such responsibility or if there is support for CoPs within HR. These are areas worthy of future research. Despite these limitations useful insights have been gained.

Issues regarding the coordination process are now considered. The characteristics of a successful CoP will then be explored using the three established CoPs – the CCoP, DLCoP and ECoP, as examples. Finally, how the SCoP performed in each of the characteristics identified will be discussed.

(i) Understanding the coordination process

While Wenger (1998a) believes there are at least seven different forms of CoP leadership, the most important form of CoP leadership for practitioners in the DLR comes from the coordinator, who is the person that manages the day-to-day activities and tasks. The interviews revealed the role of the coordinator to be in dispute. Some participants advocated external coordination (I6) while others preferred the coordinator to be a member of the CoP being coordinated (I5, I6, I3). There was a concern expressed by one informant that people in the DLR were becoming "slaves to theory" (I6). He thought the literature regarding coordination did not always reflect what worked best in practice.
Internal leadership is advocated in the literature (McDermott, 2000; Wenger, 1998a; Wenger, 2000), yet this interviewee’s argument was that people who are members of a CoP are generally very busy and do not have time to do the required administration work or “logistical grind” (I6), as he put it. This line of argument sees CoPs better served by external coordination, as it involves the simple yet time-consuming tasks of organising meetings, locating venues, sourcing catering, and finding out people’s needs (I6). Therefore, being outside the CoP being coordinated would not be a hindrance, rather it would lead to more efficient coordination.

Wenger et al. (2002) say that coordination is usually funded by the organisation. But one of the weaknesses of the coordination process within the DLR was the lack of funding it received. Not all coordinators had a dedicated budget. One interviewee suggested incorporating CoP coordination into the performance management system – which is linked to yearly progression payments – to ensure each coordinator is allocated sufficient time to dedicate to CoP coordination (I5). But this could transform CoP work from a learning experience into an administrative governance experience, which is against the CoP concept (I5). Another possibility could be to establish some form of accountability system that would make every CoP coordinator answerable to a supervisor, but this could make the CoP take on the characteristics of project work, which is anathema to the purpose of CoPs (I5).

For McDermott (2000), the most important characteristic of a CoP coordinator was the ability to relate to people, as the role is mainly about getting people to connect. This does not necessitate membership with the CoP being coordinated. Nevertheless, whether or not a CoP is served better by internal or external coordination has not been fully explored in the literature and needs further investigation. A way to expand an understanding of the coordination process could be to establish a CoP of CoP coordinators. By providing coordinators with a forum to share their strategies of coordination, it could improve the coordination process for all CoPs throughout an organisation.

(ii) Creating successful communities of practice

This section discusses attributes of successful communities of practice using the established CoPs as examples. A total of six factors, in no priority order, were identified that contributed to the success of the three established CoPs:

Dispersal (DLCoP)
The dispersal of development and learning practitioners across the state and throughout different organisational divisions creates an obvious need for a CoP (I3, DLCoP Meeting, 2009). It acts as a way to collaborate over distance and share expertise across divisional boundaries (I3, DLCoP Meeting, 2009).

Awareness of Limitations (DLCoP)
DLCoP members pointed out the weaknesses of their CoP during their meeting (DLCoP Meeting, 2009). They expressed concerns about the limitations of their online ‘teamroom’ (there was nowhere to leave comments), the difficulties in keeping in touch between meetings, and lack of attendance at some meetings (DLCoP Meeting, 2009). The identification of such limitations indicates members are enthusiastic about improving the DLCoP and are committed to its success.

One Coordinator (CCoP)
The CCoP has had the same coordinator throughout its life (I1). This coordinator has thus been able to establish recognition and to become highly networked throughout the DLR (I1).

**High Level Sponsor (CCoP and ECoP)**
Hemmasi and Csanda (2009) believe the acquisition of high-level management support is important to ensure the long term viability of CoPs, and at the DLR, the two most successful CoPs – ECOP and CCoP – both had high ranking officers to act as sponsors (I1, I5, I7).

**Pre-existing Social Capital (ECoP)**
The use of preexisting social networks for the purposeful design of CoPs has been advocated by Wenger *et al.* (2002). This study demonstrated that such a strategy can be successful. The success of the ECoP is largely due to the social networks already present amongst evaluators, as the nature of evaluation within the DLR fosters social capital amongst its practitioners. Two main factors contribute to this. Firstly, isolation is common (I7). The DLR has offices in many small country towns across the state. In many instances, each office within the DLR only has one or two evaluators (I5, I7). So there is a need for them to communicate across teams (I5, I7). Secondly, all new evaluators are invited to join the ECOp, so this provides them with an immediate support group (I7). This enabled newcomers to quickly advance to expert status, one of the defining features of CoPs (DePalma, 2009). The speedy transition of novices to experts is also facilitated by the opportunities for community members to learn through experience, a central feature of learning systems (Bawden, 2010).

**Core Business (ECoP)**
Evaluation is part of the DLR’s core business. For example, DLR projects, policies, events, strategies, workshops and initiatives are implemented using public money, so they must be evaluated to assess if they were worth the expense (I7). Accountability is maintained by evaluators, which ensures evaluation is well supported throughout the organisation (I7).

(iii) **Implications for re-designing the SCoP**

**Dispersal?**
One respondent believed the SCoP was created in an organisational silo (I10), so efforts should be made to locate systems thinkers across the DLR. The transdisciplinary nature of Systems presents the opportunity for a SCoP to work across divisional and disciplinary boundaries.

**Awareness of Limitations?**
While members of the SCoP were aware of the limitations of their CoP (under-utilised online forum, lack of coordination and lack of meetings) they were not making a comparable level of effort to address these limitations. This suggests the SCoP does not meet the needs of its members in its present form.

**One Coordinator?**
The coordinator role has been held by one person from the establishment of the SCoP. Yet he has struggled to find time to devote to coordination (I2). It is unrealistic to expect a CoP to have one coordinator for its entire existence as many CoPs have life spans lasting years while people within the DLR regularly change roles. Thus community members should have in place a successful method of transferring coordination, but the best way to
manage this transition is not well understood and worthy of future attention. Informants suggested a speedy transition is unwise (I2). Instead, an extended period of change involving the new coordinator acting in an apprenticeship role would be more likely to retain tacit knowledge and other forms of expertise within the CoP.

**High Level Sponsor?**
The SCoP lacked the same level of high ranking organisational support enjoyed by the CCoP and the ECoP in that the sponsor was not embedded in the day-to-day politics of the organisation. As systems thinking is not part of DLR’s core business, it is more difficult for systems thinkers to secure the support of a high-ranking staff member to act as sponsor (I2). But CoPs can still function without a high level sponsor, as one interviewee described the sponsor of her CoP as a “symbolic figurehead” (I7). The role of the sponsor is thus to help foster enthusiasm amongst practitioners and provide a measure of legitimacy to those within the organisation yet outside the CoP. Provided members feel enthusiastic and CoPs are permitted to function within the organisation, it is possible for a CoP to function effectively without a high level sponsor.

**Pre-existing Social Capital?**
The SCoP was lacking in social capital as interviewees spoke of the absence of meetings and the inability of members to create a forum for open debate (I2, I10, I12). This has plagued the SCoP from the beginning (I10, I12). Nonetheless, the potential for establishing social capital amongst systems thinkers remains. Like evaluators, systems thinkers are often in the minority within teams, so a need exists for them to communicate outside their own offices. Rather than waiting for social capital to establish between potential SCoP members, it could be fostered in the process of trying to establish a SCoP.

**Core Business?**
Unlike evaluation, systems thinking is not part of the DLR’s core business. Moreover, systems thinkers generally do not have systems thinking incorporated into their official position descriptions (I2), making it harder for systems thinking to gain broad support.

It would seem unlikely that Systems thinking will ever be part of the DLR’s core business in the way evaluation currently is. This is despite research evidence that outstanding leaders “think systemically and act long term…. They recognise the interconnected nature of the organization ….” (Tamkin et al., 2010, p. 7). However, by emphasising the utility of Systems for climate change adaptation – which is a core DLR responsibility - it might be possible to raise the profile of systems thinking within the organisation to a level that generates enough enthusiasm for a successful SCoP.

6.1.6 Conclusion
This research sought to scope the issues constraining or enhancing the purposeful creation of CoPs within a public sector organisation. A more specific aim was to illuminate those factors that might be utilised or avoided in creating the circumstances for the emergence of a community of practice based on systems thinking within the DLR. The authors' theoretical framing, supported by the literature, is that CoPs cannot be engineered, but the circumstances for their emergence and continuance can be understood and managed (Blackmore, 2010). Interviews were undertaken with DLR employees who see themselves as members of CoPs. The research shows that within the DLR there are currently six named CoPs in one of two stages of development, including a systems thinking CoP. There were three established CoPs, three struggling and no CoPs existing between the two extremes of ‘struggling’ and ‘established’. It was
beyond the scope of this research to explore CoPs that have emerged spontaneously within the DLR and continue to operate ‘below the radar’.

It is argued that a successful CoP is one whose members: (1) demonstrated a sense of stakeholding or ownership of their CoP topic; (2) demonstrated a willingness to participate in meetings and in the sharing of expertise; (3) communicated with members in meetings and between meetings, and (4) identified gaps in their knowledge and attempted to fill those gaps by, for example, suggesting new topics for meetings. The concept of enthusiasm was found to be useful as its presence or absence amongst community members largely determines the success of a CoP.

The SCoP did not compare with DLR’s established CoPs as it lacked a ‘politically embedded’ high level sponsor and pre-existing social capital. As systems thinking is not yet part of DLR’s core business it was difficult to foster broad support for a CoP based on Systems Science. Moreover, by situating the SCoP within an organisational silo the potential for interdivisional and interdisciplinary collaboration was reduced. While SCoP members were aware of limitations of their community they have not demonstrated the level of collaboration required to address such limitations. Similarly, the same person has been acting in the coordinator role since inception but has not dedicated sufficient time to coordination due to other responsibilities.

Practitioners aiming to create a successful community of practice ideally would: (1) avoid creating a CoP within an organisational silo; (2) build upon pre-existing social capital amongst potential members; (3) use one coordinator throughout the life of the CoP (or have in place a successful method of transferring coordination); (4) gain the support of a high ranking officer embedded in the political life of the organisation to act as sponsor; (5) engage in reflective practice that attempts to overcome the constraints to effective functioning of the CoP, and lastly; (6) ensure the focus of the CoP reflected the organisation’s core business. However, it may be appropriate to step back and consider the strategic organisational context before proceeding. This may reveal a need to (i) build or reveal a discourse of organisational imperative/need; (ii) gain organisational commitment and support structures for the CoP concept, including sponsors, funding, allocation of time, etc; (iii) foster or facilitate individual motivations to participate in a CoP (enthusiasm, ownership, etc) and (iv) develop the means to value and communicate individual and organisational benefit from CoP participation (learning, improved delivery on core business, communication, etc).

A possible area for future research attention is the role of the community coordinator. In particular, it was not clear how to deal with a change of coordinator to ensure knowledge and expertise was retained by the CoP. Another area of concern regarding coordination was whether or not the coordinator should be a member of the CoP he or she is responsible for. While the literature advocates internal coordination (McDermott, 2000; Wenger, 2000; Wenger, 1998a), sometimes this is not possible in practice due to heavy workloads. While CoPs undoubtedly require a coordinator, the most practical and effective mode of coordination remains uncertain.

As this study revealed, creating successful CoPs is more than a business or managerial concern. Social capital plays an important role, and while it has already been acknowledged there are social aspects to learning within organisations (Gherardi et al., 1998), the contribution of social capital to successful CoPs is still not well understood. In line with previous studies cautioning against top-down approaches to CoP design (Swan et al., 2002), future studies could explore strategies for fostering social capital amongst employees, as it could provide the conditions required for CoPs to emerge. Moreover, it has been argued that CoPs, with their social aspects, can help overcome organisational silos (Rashman et al., 2009). Yet this study revealed an organisational silo to be a
hindrance to purposeful CoP creation. Therefore, future studies could also examine how to initiate incipient CoPs in contexts where silos exist.

Our research was not designed to understand how the organisational and institutional contexts shaped participation in CoPs, nor how they could be leveraged to enhance organisational learning. This is clearly an area of need and opportunity for public sector organisations like DLR. As Snyder and Wenger (2010b) note “distinctive competencies in today’s markets depend on knowledge-based structures that are not restricted by formal affiliation and accountability structures. The most distinctive, valuable knowledge in organizations is difficult or impossible to codify and is tightly associated with a professional’s personal identity. Developing and disseminating such knowledge depends on informal learning much more than formal – on conversation, storytelling, mentorships, and lessons learned through experience (p. 127).” The further exploitation of CoPs ideas in conjunction with generic systems thinking and practice capability building is worthy of greater consideration if public sector organisations are to be more adept at managing complex, or ‘wicked’ situations such as climate change adaptation (APSC 2007).

What is known about the purposeful creation of CoPs is based largely upon studies within private sector organisations. This study goes some way towards redressing this imbalance, but more studies are needed on CoPs within public sector organisations. Such studies could contribute to the development of more appropriate knowledge management practices, as public sector CoPs may differ substantially from those in the private sector. Other areas for future study could assess the capacity of an organisation’s HR division to purposefully design CoPs. The establishment of a CoP of community coordinators as a way to promote organisational learning of CoPs is suggested. Future studies could incorporate participant observation and long-term ethnographic research to assess the veracity of claims made by interviewees and the feasibility of the above suggestions. More in-depth analyses would also be able to elucidate the conceptual and praxis boundaries between CoPs and CoIs, which currently remain unclear.

6.2 Recommendations for action and research by DPI arising from this scoping study

A number of recommendations specific to DPI arise from this work, in addition to the conclusions of the paper. These are:

i. Make links between systems thinking/practice and climate change adaptation as a way to promote systems concepts throughout DPI (i.e. introduce a systems strand to the climate change CoP);

ii. Foster more social and relational capital amongst systems thinkers across DPI, through the following possibilities:
   a. Invest in reinvigorating the STCoP;
   b. Build (rebuild) stakeholding in the STCoP through forming a cross division steering group from which the coordination function is resolved, and;
   c. Re-explore and re-articulating purpose in the revitalised constituency;
   d. Identify and recruit new champions;
   e. Build formal ‘scaffolding’ arrangements with external collaborators with similar interests;

iii. Recommendations to DPI management
   a. Allow more time for CoP participation by staff (e.g. through KPIs)
   b. Determine if HR division could design/manager CoPs.

iv. Recommendations for CoP coordinators
a. Establish a CoP for CoP coordinators for support and as a way to share admin tips.
b. Establish a means to change coordinators that minimises loss of expertise and maintains CoP momentum.

v. Recommendations for CoP members
   a. Take a more active role in CoP success.
   b. Provide support to coordinator in day-to-day CoP functioning.
   c. Continue to address whatever generates enthusiasm.

vi. General comments
   a. The value of CoPs still appears to be under-acknowledged by higher management. To help maintain CoPs, there needs to be a way for their worth to be demonstrated to higher management.

Chapter 7 Strategic opportunities for FFSR within DPI, and beyond, based on Systems capabilities

7.1. The ‘formal’ context

DPI holds a significant place in the research and development (R&D) contribution to Victoria’s agriculture and primary production. The following claims are made regarding the place of Agriculture in Victoria and regarding DPI’s role:

Victoria is Australia’s largest food and fibre exporting state. Our strong agricultural sector produces goods valued at around $9 billion a year, or 26 per cent of the national total. Victoria’s temperate climate, high quality soils and clean water support world-class agriculture industries and the state’s largest export earner, the dairy industry, which provides about 13 per cent of dairy products traded globally.

We enable Victoria’s agriculture and food sectors to maintain and enhance a reputation for world-class food by sustainably increasing wealth, employment and investment in regional communities.¹²

Within DPI, Future Farming Systems Research Division (FFSRD) pursues the following vision and aims:

‘The vision for Future Farming Systems Research (FFSR) is to develop innovative farming systems that deliver production and environmental benefits for the temperate zone of south east Australia.

The work of FFSR focuses on two platforms: Agrifood Production Systems and Agricultural Resources. FFSR also has major responsibility for the delivery of two components of strategies associated with the Victorian Government’s Future Farming Strategy. These are high productivity in the dairy industry and new technologies and strategies which will focus on increasing resilience to climate change for the horticulture, livestock and cropping industries.’

The vision for FFSRD is framed within an espoused commitment to science understood as:

DPI takes a pro-active approach to the maintenance and building of Victoria’s scientific capability and is committed to the provision of high quality, innovative science and technology to create robust primary industries that generate strong economic activity throughout the State.

“enabling departmental performance” and “develop partnerships and engage with industry, community and other stakeholders” (p. 7).

7.2 ‘Framing choices’ and boundary judgments about situations

The adapted use of SSM (soft systems methodology) enables these public ‘framings’ of FFSRD’s mission to be better appreciated. This can be done by looking at the main verbs, the ‘doing words’ in the public statements cited above. Through this process an outsider ought to be able to understand, in broad conceptual terms, what is done by the DPI, and FFSRD in particular, to achieve its mission. The key verbs are:

(i) **enable** Victoria’s agriculture and food sectors to maintain and enhance a reputation for world-class food by sustainably increasing wealth, employment and investment in regional communities;

(ii) **develop** innovative farming systems that deliver production and environmental benefits for the temperate zone of south east Australia;

(iii) **deliver** two components of strategies associated with the Victorian Government’s Future Farming Strategy, viz:
   a. high productivity in the dairy industry, and
   b. new technologies and strategies which will focus on increasing resilience to climate change for the horticulture, livestock and cropping industries

(iv) **provide** high, quality, innovative science and technology to create robust primary industries that generate strong economic activity throughout the State.

Items (1) and (iv) are higher order processes than (ii) and (iii). This can be expressed using the systems concept of the ‘black box’ (Figure 7.1)
The first transformation depicted in Figure 7.1 is essentially a political statement. DPI organizationally, as a key value, conserves the ‘provision of high quality, innovative science and technology’ as its means to effect the key transformations of concern as shown in Figure 7.1. The key ‘measure of performance’ implied in these statements is level of economic performance. What is not clear at this level of analysis is the relative priorities, in strategic terms, that are associated with gross, net or balance of trade measures of income. Nor is it clear where the boundary is placed around the ‘system of interest’ conceptualised by the DPI. For example is rural tourism, the provision of ecosystem services, high value local foods etc within the economic measures used to judge performance?

The relevance of these questions here are that what the DPI does is fundamentally built on the underpinning paradigm that is applied in setting the strategic framing for the organization. Donella Meadows, of Club of Rome fame, and an internationally recognised systems thinker and practitioner recognised nine levels of concern to a systems thinker intervening in a complex situation (see Ison 2010 Chapter 4):

9 Numbers (subsidies, taxes, standards)

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13 Please note that this figure is drawn in free hand on purpose. Diagramming is a key element of systems practice and as such needs to be part of everyday practice. Opportunities should be maximised within meetings and workshops to use diagramming as an aid to learning and conceptualising. To achieve this function they do not need to be ‘professionalised’ as this is unnecessarily time consuming and minimises the key practice elements.
In her paper Meadows numbered these ways of intervening from 9 to 1. From her perspective number 1, paradigms, was the most important. However, she noted that amongst traditional decision makers the order was often the reverse.

In the context of this research two issues arise that are of strategic importance to DPI, and thus Victoria. The first concerns whether the framings of the key transformations depicted in Figure 7.1 are still adequate for situations best understood as complex adaptive systems or coupled social-ecological systems? For example the main characteristics of complex situations are:

- Cause/effect relationships can be only established in retrospect
- There are multiple variables, each evolving without communication with the others
- The control of key variables sits outside the organization
- Command and control methods of hierarchical management make the problems worse
- No one person or team can know or access the indispensable information on a consistent basis

The research reported from Inquiry 2 (Chapters 3-5) provides convincing evidence that the situation of CCA research is best framed in terms of this set of points (i.e., as a complex situation or a ‘wicked problem’). Put another way the old paradigm built on the ‘knowledge transfer equation’:

Research → knowledge → transfer → adoption → diffusion

is no longer fit for purpose in such situations (Ison and Russell 2007).

The second issue concerns the underlying paradigm for thinking about agriculture itself. The matters at issue are depicted in Figures 7.2 and 7.3. Lang and Heasman (2004: 21) have summed up what they see as the likely trajectories globally for food supply. They begin with what they call the ‘productionist’ food supply paradigm that has been dominant since the 1930s. This paradigm, they argue, is currently being challenged, and is likely to be replaced, by either (or both) of two competing paradigms:

- the ‘Life Sciences Integrated’ paradigm – which includes biotechnology, and/or
- the ‘Ecologically Integrated’ paradigm – which consists of ecologically sensitive forms of production, such as agro-ecology, organics, etc.

Lang and Heasman (2004) argue that both of these paradigms are “science-informed” but are very different in their implications for both food production and human health.
### Food supply paradigms

(Lang & Heasman 2004, *Food Wars*)

#### Productionist paradigm
- Commitment to raise output
- High-input agriculture; monoculture
- Pursuit of quantity and productivity over quality
- Assumes limitless natural resources; externalisation of waste/pollution
- Marginal interest in health

#### Life sciences integrated paradigm
- Science-led integration of supply chain
- Capital-intensive use of Life Sciences
- Aims for industrial-scale application of biotechnology
- Intensive use of biological inputs
- Novel but unproven impact on health

#### Ecologically integrated paradigm
- Risk minimisation by building diversity
- Whole-farm systems approach
- Aims to move organic foods to mainstream
- Resources are finite; need to move away from extensive monoculture
- Presents itself as ‘healthy’ alternative

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**Figure 7.2** Paradigms on which future food production are likely to be based as argued by Lang & Heasman (2004). (Source; J Dibdin, SGES, Monash University).

On the evidence from our engagement with DPI the field of CCA research highlights many of the tensions associated with transitioning between paradigms. The future trajectory is also clearly contested within DPI and in-house institutional arrangements do not seem conducive to negotiating at the level of underlying assumptions or paradigm. This is likely to apply particularly at the level of project formulation. Contestation over trajectory was also a feature of the IAASTD process (McIntyre et al 2009). In the IAASTD synthesis report it is noted that there is:

*widespread realization that despite significant scientific and technological achievements in our ability to increase agricultural productivity, we have been less attentive to some of the unintended social and environmental consequences of our achievements. We are now in a good position to reflect on these consequences and to outline various policy options to meet the challenges ahead, perhaps best characterized as the need for food and livelihood security under increasingly constrained environmental conditions from within and outside the realm of agriculture and globalized economic systems.*

The Lang & Heasman (2004) framing of paradigms is not the only model currently in the international discourses about future agricultures. Another prominent framing is that based on multifunctionality (Figure 7.3). Wilson (2007) argues that strong multifunctionality engenders *synergistic mutual benefits between individual actions and processes (e.g. landscape protection and food quality; direct marketing and rural community embeddedness etc) and, therefore is good for the environment, good for farmers, good for rural social relationships and governance structures, good for food quality, and good for agriculture-society interactions in general*’ (p. 228). He further argues that agricultural systems characterised by weak multifunctionality do not have these features and have weak environmental sustainability. Strong multifunctionality is thus systemic; weak multifunctionality systematic (Ison 2010).
Figure 7.3 A conceptual model of weak, moderate and strong multifunctionality (Source: Figure 9.4 in Wilson, 2007).

Hubert et al (2010) argue that 'in order to design tomorrow’s agriculture, public policies and research programs must be based on clearly defined strategies and priorities from now on, relying on foresight studies.' This claim raises significant points for FFSRD’s strategic direction. The first is the recognition that future agricultures are the product of design. This in turn prompts the question: who are, or should be, the designers? It also raises questions about the design process, e.g. through foresight activity, as used in the French example (Hubert et al 2010) or other design processes such as Agroecosystems Analysis (Appendix 10.9) or other Systems approaches. For the French agricultural researchers a key design consideration, and one highly compatible with systemic perspectives was based on the concept of “controversial dialogue”, a process based on dialogue, i.e. tolerance, mutual respect and the ability to listen attentively, and on controversy, i.e. highlighting and arguing the main differences and oppositions regarding assumptions and methodologies.
7.3 Locking in historical patterns or creating transformative leaps?

A focus of the three inquiries has been to elucidate some of the systemic implications of historical and current ‘framing conditions’ associated with research practices, particularly in situations where Systems approaches are likely to offer the most opportunity, such as CCA research. We have also set out to identify constraints and possibilities (associated with initial starting conditions) for the development and deployment of Systems capabilities within DPI and FFSRD in particular. In this regard the current ‘project model’ and associated project cycle presents both constraints and opportunities. Box 7.1 presents a mini-case study of success in deploying Systems within the DPI that is associated with the project/practice cycle.

**Box 7.1**

**Deploying Systems to advantage – the case of DPI Chemical Standards**

This mini case study is based on a presentation made by staff of the DPI Chemical Standards Branch as part of the SDI-run Systems course. In this case staff of Chemical Standards attended as a group and self-reported at the end major new insights and capabilities for doing their job. The factors contributing to this outcome were:

(i) attendance as a work team;
(ii) critical engagement with the Systems course concepts and techniques between the formal sessions in relation to real work issues;
(iii) presence of a champion;
(iv) application of concepts to past, present and anticipated future work issues – e.g. recognition that the complexity of many of the situations faced by chemical standards branch were not simply jigsaws (Figure B7.4);
(v) recognition that Systems ideas had to be embedded in a process model related to practice and that joined up strategic and operational considerations (Figure B7.5).
(vi) inviting other key (internal and external) stakeholders into a process of co-creation, or negotiation, of how to work together in future.

![Complex issues are not like jigsaws.](image)

Figure 7.4 Recognition by staff of Chemical Standards Branch that complex issues were not like jigsaws.
This research presents a strong case for rethinking the project management model and the project cycle for many, but not necessarily all of, DPI’s future activities. Future CCA research, which will by necessity be increasingly embedded in most projects seems a good starting point to experiment with alternative ‘project’ or ‘program’ models. Systems approaches have more to contribute to this process than we have been able to demonstrate in this, as yet, short collaboration. The case study highlighted in Box 7.1 raises interesting questions of why some areas of DPI (and other state government departments) have been better able to benefit from the Systems training than others?

7.4 Using systems approaches strategically

7.4.1 A systemic inquiry into DPI’s Future Farming Systems strategy

Systems approaches are most useful when they are built into everyday practice, or where they are purposefully chosen to illuminate a situation of concern, or to chart a way forward when there is lack of clarity about purpose, or where direction is open to multiple interpretations or is contested. As outlined in Chapter 1 ‘systemic inquiry’ is an approach to systems practice which acknowledges uncertainty from the start.

All too often it is assumed that because strategy is committed to text then it will be easy to follow and implement. Our engagement with DPI through this research shows that this is not the case. In fact one of the limitations faced by research managers within DPI’s VCCAP portfolio was the lack of a common conceptualisation of the CCA research situation. This created particular demands on those responsible for ‘joining-up’ the research that was done and in articulating a coherent meta-narrative from the findings.

For this reason a small case study, structured as a systemic inquiry, is presented here to exemplify how the adapted use of SSM (soft systems methodology) could be used with stakeholders in research to gain greater clarity of purpose, reach agreed boundary judgments (what is in or out), agree measures of performance and tease out a common appreciation of the key activities required to make the systems of interest effective. This approach could readily be incorporated within the early phases of the project cycle (see Figure 2.5) and returned to on a regular basis as a means of monitoring learning and adapting to changed circumstances.
The starting point for this systemic inquiry was the description of item 3.2, entitled ‘New Technologies & Strategies; published in DPI’s “Future Farming” (2008). The full text in that section reads:

‘New investment of $6.22 million over four years will be available to provide lamb, grains and horticulture farmers with new technologies and strategies to enable them to adapt their specific farming systems and practices to future climate conditions. These new technologies and strategies will be derived from the latest research and will integrate with existing and planned government and industry practice change programs to ensure that farmers have access to the best and most appropriate management packages.’

**Methodological approach**

- An adaptation of SSM was used which involves working backwards to ‘a situation of concern’ (e.g. implementation) from what is written in a policy document (in this case 3.2 in ‘Future Farming’).
- Optional - build a joint ‘rich picture’ of context/situation of this proposed action.
- Brainstorm some possible ‘systems’ that seem relevant to this situation.
- Start with ones devised from the written text. Then add some “out of the box” suggestions.
- Describe all potential ‘systems of interest’ in the form: ‘A system to do P by Q because of R’, where:
  - P = what
  - Q = how
  - R = why

**Examples**

1. The first possible system of interest derives from an interpretation of the text in 3.2 (above) as literally as possible.

   A system to ……provide lamb, grains and horticulture farmers with new technologies and strategies …* to enable them to adapt their specific farming systems to future climate conditions….by conducting research that will integrate with existing and planned government and industry practice-change programs…..using $6.22 million of investment over four years.

   * in the form of, or as part of ‘the best and most appropriate management packages’.

A TWOCAGE for the ‘system of interest’ described above is given next (Table 7.1). TWOCAGE(S) is a mnemonic derived from practical action research and based on Checkland’s original CATWOE mnemonic, a device to aid generating good ‘root definitions’ of possible systems of interest.

<table>
<thead>
<tr>
<th>Table 7.1 An analysis of DPI strategy based on the TWOCAGE mnemonic.</th>
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</thead>
<tbody>
<tr>
<td><strong>Items in the mnemonic</strong></td>
</tr>
<tr>
<td>Transformation – what the system does</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td>Worldview that underpins the system</td>
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<tr>
<td>Role</td>
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<td>-------------------------------</td>
</tr>
<tr>
<td>Owner – person or group with</td>
</tr>
<tr>
<td>power over the system</td>
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<tr>
<td>Client or Customer – those</td>
</tr>
<tr>
<td>served by the system</td>
</tr>
<tr>
<td>Actors – those who act to</td>
</tr>
<tr>
<td>make the system function</td>
</tr>
<tr>
<td>Guardian(s) those who look</td>
</tr>
<tr>
<td>after the interests of the</td>
</tr>
<tr>
<td>affected but not involved</td>
</tr>
<tr>
<td>Environment in which system</td>
</tr>
<tr>
<td>exists</td>
</tr>
<tr>
<td>System of interest</td>
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</tbody>
</table>

Those involved with DPI could then ask the following questions concerning measures of performance in relation to the 'systems of interest.

- e1 = efficacy = is the transformation working;
- e2 = efficiency = is the 'how' delivering the transformation with minimum resources?
- e3 = is the transformation meeting the higher level purpose (i.e. R) = enabling farmers to adapt their farming systems to future climate change?

Conceptual Model Building = S in TWOCAGES. The process involves generating a list of all the verbs in the system description (above) as well as others that seem necessary from the perspective of those doing the modeling.

- Verbs
  - Provide….
  - Enable…..
  - Adapt…..
  - Conduct….
  - Integrate….
  - Use…..
  - Know…..best/appropriate
  - Know…..who lamb, grain hort farmers are.
  - Know future climate conditions…is this possible?
  - Know existing planned…..practice change programs.

A conceptual (activity) model of the system described by the root definition is given below (Figure 7.6). This is a second iteration model – usually those preparing models have to learn their way to something they are happy with.
Figure 7.6 Conceptual activity model of the system described by the root definition

How could FFSRD learn from this simple and practical inquiry?

The following possibilities suggest themselves:

(i) How, if at all, are the activities described in the model carried out in ‘real life’ by FFSRD (or others)?

(ii) How well are activities currently carried out (if they exist) and what are the implications if some are not carried out?

(iii) Who could benefit from learning about the answers to (i) and (ii)?

(iv) What are the strategic and practical implications of deciding to have the activity ‘undertake climate change research’ outside (or inside) the system of interest? (i.e. of making particular boundary judgements);

(v) What, if any, measures of performance exist at the moment to evaluate the success, or otherwise of 3.2 and the expenditure of $6.22 million?

2. A ‘root definition’ of a system of interest: an ‘out of the box’ system. Innovation can come from thinking imaginatively about alternative systems of interest. For example the material in 3.2 could be reworked as:

- A system to … understand current farming systems conducted by lamb, grain & horticulture farmers by jointly learning with stakeholders the key features of on-
going viability in an environment of changing climate so as to build agro-
ecosystem resilience.

This potential ‘system of interest has a different Worldview, one that appreciates the role of learning and adaptation as a collaborative process involving farmers (and others). Thus when modelled it would give rise to a different set of activities and relationships. The modelling for this system is not provided, as the key to SSM practice is responding to the question ‘who learns in the process of doing SSM? If key DPI staff were to carry out the modelling of these two systems of interest then they would (i) engage in considerable learning; (ii) come to an informed view about what, in the situation was systemically desirable and culturally feasible; (iii) make explicit the underpinning worldviews (paradigms) for particular strategies and (iv) arrive and common understandings of purpose and measures of performance. It is thus likely that implementation and evaluation would be significantly enhanced.

Other systems approaches could usefully be deployed as part of such an approach. In this particular case use of the VSM (Viable Systems Model, as introduced to DPI via Dr Angela Espinosa), might usefully reframe understandings about the nature of viability of farming systems as part of a process of climate change adaptation.

7.4.2 Using SSM in every day circumstances

SSM can be used in every-day situations. We exemplify this by drawing out some relevant root definitions of systems of interest of those interviewed as part of Inquiry 2. A root definition is a way of describing a possible, or potential, or implicit system of interest. This is something that can be conceptualised as part of any group interaction and is a way to make explicit one’s thinking or the thinking of others. A root definition takes the form ‘a system to do something (P= what) by Q (= how) because of R (= why). The mnemonic PQR thus depict a system, sub-system and supra system. The set of root definitions shown in Table 7.2 have been generated by the researchers from DPI staff interviewed as part of Inquiry 2 (see Chapters 3-5). Each root definition depicts what the researchers perceived as the dominant systems of interest that motivated the particular respondent. We make no claims that these are what the respondents themselves would claim, however in a second cycle of research, if this were possible, we would use these root definitions in a process (i) checking out with respondents and (ii) as a basis for design of future interactive processes e.g. for project development for example or for teasing out the strategic and operational implications of key staff implicitly enacting or managing such a diverse range of ‘systems of interest’.

<table>
<thead>
<tr>
<th>Table 7.2 A construction of root definitions of participants conceptual (activity) models based on Inquiry 2.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What (P)</strong></td>
</tr>
<tr>
<td>To provide decision support by narrowing the problem complexity</td>
</tr>
<tr>
<td>To understand the impact of climate change on plant physiology by experimenting with parameters of temperature, carbon dioxide, and water</td>
</tr>
<tr>
<td>To understand opportunities arising from change by recognising alterative farming ‘system’ inputs, e.g., for high protein diets,</td>
</tr>
<tr>
<td>To extend climate by providing a basic climate</td>
</tr>
<tr>
<td>Knowledge through rural stakeholders and emissions education</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>To respond to changes in policy agendas by translating existing capability and to better target capability</td>
</tr>
<tr>
<td>To increase the ability for new thinking and innovation by providing opportunities for new conversations</td>
</tr>
<tr>
<td>To embed ‘change’ into ‘good’ government policy as something we have to respond to by recognising standards in the effects of actions taken</td>
</tr>
<tr>
<td>To move beyond marginal adjustment stymied by doubt and uncertainty by realising efficiencies against a changing competitive environment and resource constraints</td>
</tr>
<tr>
<td>To support the transition towards a low carbon economy by recognising the socio economic effects of changes in the environment</td>
</tr>
<tr>
<td>To create awareness of climate change issues and adaptation and mitigation options By engaging communities in discussion on issues around climate change</td>
</tr>
<tr>
<td>To develop germplasm suited to new climatic conditions By identifying the sorts of traits and management practices needed for changed environments</td>
</tr>
<tr>
<td>Help stakeholder better understand implications and opportunities and feedback their perspectives back to science and extension By engaging with and consulting peak industry bodies</td>
</tr>
</tbody>
</table>

### 7.5 Capability-building for systems practice in FFSRD, DPI and beyond

It is clear that any opportunities Systems approaches offer to FFSRD and DPI will not be realised unless capability is built. Evidence suggests this would best be achieved in work groups and where there is obvious high-level championing. So far this has been absent in FFSRD. It is ironic that interest in the SDI-led Systems training is expanding amongst other DPI and non-DPI staff at a greater rate than within FFSRD.

The three inquiries undertaken as part of this collaboration indicate evidence of need and opportunity for enhancing capability for deploying Systems approaches in research.
practice. The next chapter indicates one area of future research that we regard as worthy of future funding based on this initial one-year scoping period.
Chapter 8 Second Phase of Research

8.1 Future opportunities

This chapter outlines a case for further engagement by the Monash group with the DPI CCA research community. It does so by reflecting on the responses to two of the interview questions from Inquiry 2. These were:
(i) What type of barriers do you think exits for research to make a difference on the ground?
(ii) Is there something you wish to emphasise or anything else you think is important to this discussion?

Our aim is to open up discussion on how to purposefully act more systemically in realising CCA. This analysis forms the basis of designing a systemic intervention which we propose is subjected to scrutiny of those involved in the situation to critique, add to, take away from and endorse as a culturally desirable and feasible transformation.

In Inquiry 2, participants were asked to describe what barriers existed for CCA research to make a difference on the ground. They were also provided an opportunity to reflect on the discussion and raise any areas of emphasis or to name important issues missed in the initial interviews. From these two cycles of data collection a view of desirable and feasible change as a result of doing CCA research can be generated.

Participants identified some of the significant barriers as:
- research distance from decision makers;
- psychological barriers and denial;
- raising awareness in the community; and
- project funding and management.

Participants perspectives on how to improve the situation were classified into five key areas for potential intervention and innovation:
1) breaking conceptual barriers to integration including building capability in collaboration;
2) developing opportunities to do things differently by including end users of research in the research design process and through focus on particular issues or local context;
3) being explicitly aware of historical aspects of the situation including the changed relations and new issues associated with new challenges for development;
4) taking a step back to improve perspective on what often seems to be fragmented opportunities of foresight and intervention; and
5) overcoming barriers to building adaptive capacity through discussions that enable a view of local interactions between climate and environment in different timescales.

In response to these areas there are four opportunities for design and development of systems theory and praxis:
- Connecting research up to decision makers in policy, business and communities through theory informed processes of research design and development
- Increasing dialogues within internal and external communities of interest to engage with CCA research issues
- Facilitating co-research with farmers and others willing to innovate as a device for opening up areas of leadership in CCA
Facilitating social learning (Ison et al. 2007) for development and management of CCA research as a social technology for increasing capacity in research management of complex issues

The following possibilities to continue the research program in developing a framework for systems thinking theory and praxis in DPI’s CCA research are offered. If pursued they offer potential in facilitating what might be perceived as the important ‘step changes’ the DPI must go through to realise itself as a complex learning adaptive organisation.

1) Ascertaining how communication on new research possibilities may be opened up and internal and external collaborations facilitated.

2) a) Asking how research can be cycled through from endings to beginnings through a reflective process of learning from actions taken; and with a second component b) focused on how awareness of other stakeholders in the research environment and internal and external research collaboration can be facilitated.

3) Engaging a steering group to define multi-disciplinary teams and facilitate processes of collaboration across disciplines in research design with stakeholders.

Figure 8.1 Current activity ‘models’ within the situation of research management practice

As a model of the current situation Figure 8.1 summarises three aspects of CCA research practice that participants’ responses suggested as the current areas of practice (detailed in Appendix 10.7). These include:

- rational action - research in the field of linear (cause and effect) experimentation supporting decisions with facts about nature;
- practical action – manager and stakeholders mobilising metaphor and other discursive means of supporting individual capacity to respond;
- social action – policy areas or discursive regimes associated with governing CCA research including managing capability, action accountability and new conversations.
Our research interviews suggest an opportunity to expand upon existing capability and more fully realise the potential that participants perceive as practitioners and stakeholders in research management. For example, some participants wished to change their own practice towards more collaborative and open processes to jointly define research questions and the possibility for improved integration of activities across different divisions and disciplines. At the same time we recognise there are considerable constraints in being able to open up research inquiry to process and context in which there are uncertain outcomes. These are largely configured by the history of management practice in the public service which has been oriented to governing efficiencies and a tendency to reduce complexity to its more manageable components.

Opportunities for realising a more systemic and adaptive framework for CCA research exist and are warranted. Based on this first phase of our systemic inquiry exploring discourse in the wider context, framing of policy responses and actual practice of CCA research a framework for future CCA research design and development would benefit from three areas of systemic consideration (Table 8.1; see Appendix 10.8). These are in research design and process which builds stakeholding and collaboration; decision ‘making’ and learning; and monitoring and evaluation.

Table 8.1: Three aspects* of design consideration in future CCA research

<table>
<thead>
<tr>
<th>Area for research investment</th>
<th>Key concern</th>
<th>Underlying research questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholding and collaboration</td>
<td>different stakeholding will result in different research design and with multiple stakeholding design processes will need facilitation</td>
<td>how can considerations be given to stakeholding and collaboration to influence the way research is framed and conducted?</td>
</tr>
<tr>
<td>Decision making and learning</td>
<td>research contributes to the narrowing of context for specific decision frames and in this way ‘makes’ the conditions for decisions; framing assumptions need to be open to revision and learning</td>
<td>how can decisions be learnt from as constraining and enabling particular possibilities and revised in the context of learning about how assumptions condition subsequent steps?</td>
</tr>
<tr>
<td>Monitoring and evaluation</td>
<td>accepting a dynamic environment in which decisions and their subsequent actions alter the original circumstances in which decisions were originally made</td>
<td>how can change arising from actions taken be monitored against desired outcomes such that both can be altered by the process of evaluation and learning?</td>
</tr>
</tbody>
</table>

*these aspects are inter-related with the outcomes of one providing input for the other and thus are not seen as mutually exclusive but relational and iterative

The next section explains and demonstrates how these three areas of consideration can be incorporated in the systemic and adaptive design of CCA research. It outlines a framework for development of an ARC Linkage proposal in partnership with the DPI and the Gippsland local government network as an illustration incorporating the three areas as systemic and adaptive research design principles.

8.2 Emergent opportunities

8.2.1 Development of Gippsland ARC Linkage Proposal
Currently an ARC Linkage Project conceptual model is under development to support DPI in its suggestion to rollout its climate change study in South West Victoria to other industries and regions across the state (Appendix 10.10). This presents an opportunity to...
learn from these developments and add value to understanding how the different relationships of stakeholding and collaboration bring forward different ‘knowledge’ of impacts and adaptation. At the moment we are considering three means of enabling institutional adaptive capacity as noted through comparative analysis of stakeholding and collaboration; decision ‘making’ and learning; and monitoring and evaluation to reflect on the ‘industry-based’ process in the South West and a ‘resource-based’ process in the Goulburn Broken irrigation work. A third case for comparison may generate different stakeholding in another region, e.g., Gippsland, and subsequently a different set of knowledge demands on understanding impact and timely and effective adaptation responses.

Wellington Shire have approached DPI and are developing a proposal of collaborative research addressing climate change impacts and adaptation for the Gippsland Local Government Network (GLGN), with the possibility of further stakeholding with DPCD and DSE (Appendix 10.11). A historical analysis of DPI CCA research case studies will be used to develop a community-based framework for stakeholding and collaboration; decision ‘making’ and learning and monitoring and evaluation. Monash researchers have developed a proposal to contribute to the facilitation of that process of collaborative research. In addition to adding value to the overall project by preparing an ARC Linkage bid to monitor and evaluate adaptation from the perspective of social learning Monash researchers would undertake the following important roles:

- Enable an open process to facilitate shared learning amongst diverse stakeholdings in the research program
- Facilitate conceptual integration of biophysical and social information and knowledge relevant to the Gippsland climate and adaptation context(s)
- Encourage the accommodation of diverse perspectives of the situation and thereby increasing the capability for critical evaluation
- Assist collaboration and stakeholding in the design and development of decision support systems enabling short, mid and long term adaptation

8.2.2 ARC Draft Project Description

(i) Aims

Coming to terms with global warming requires a transformation of how humans understand and respond to changing natural and social environments. From an international perspective, global climate projections open the possibility for reflecting on how climate impacts our way of life and creates new opportunities for conceptualising sustainable livelihoods in food and fibre production. However, future agricultural communities will require a significant shift from traditional institutions and framings of rural and agricultural development that are becoming increasingly difficult to sustain against a changing climate and associated natural and social dynamics. Such a concern would benefit from an understanding of how climate knowledge is socially constructed to reflect on how research engages stakeholders and communities in interpreting local climate impacts and developing adaptation responses.

Climate change has been characterised as a ‘wicked problem’ involving complexity, uncertainty, potential conflict and confusion particularly in being able to pre-empt change and accommodate uncertainty for the purpose of taking desirable and feasible governance action. The ability for building a collective social response to climate change is constrained by existing scientific institutions, for example resistance shown by both proponents and opponents of carbon emissions trading has made it clear that this is not simply a matter for scientific investigation but one which must accommodate a range of expert and non-expert perspectives. In light of such constraints and given increased competition for scarce natural resources climate change has the potential to lead to a breakdown of social cohesion and reduction in the sustainability of livelihoods strongly
dependent on fossil fuel resources. Issues such as climate change are recognised for requiring new investment in collaborative capacity for social change (APSC 2007; NCEP 2007). However, despite the conflict and confusion in the global politics of climate change there are opportunities to develop new research relationships for understanding and learning about climate impacts and adaptation at a local level.

This research will be modelled on decision support techniques as a social technology (Box 8.1) used in analysing complex socio-natural issues such as natural resources management. Decision support techniques have opened local inquiry spaces for recognising impacts and analysing possible actions against desired outcomes from a multiple of perspectives (Ewing, Grayson and Argent 2000; Argent and Grayson 2003; Stirling and Mayer 2001). Such applications have empowered local actors to contribute to the design and efficacy of social technologies in creating constructive capability for local understanding and adaptation of changing social and natural resource relationships. This research will build on this knowledge to provide an understanding of how social technologies such as impact analysis and decision support mediate social learning process in climate change adaptation. It aims to explore the relationships between researchers and research subjects to understand how processes of collaborating, learning and evaluating lead to better or worse trajectories and performances of sustainable livelihoods.

**Box 8.1 Social technologies**

Social technologies are in the broadest sense those things that are designed to intervene on social groups or the whole of a society for particular social purposes. They are part of what gets institutionalised in the set of rules that mediates interactions between people and in some respects similar to physical technologies that intervene on processes and elements in natural environments for achieving specific human purposes. Ison (2010) recognises ‘management’ or ‘decision making’ as a social technology when behaviours are standardised in the ‘procedures and rules’ through which “practice becomes reduced to sets of techniques used routinely without awareness of the origins of, and implications of the use of, such techniques, the role of the practitioner and the need for contextual understanding about the situation.” (Ison 2010, p. 106).

Awareness of the origins of social technologies is routinely lost when they become black boxed or “embedded in daily practices, including our language and use of numbers” (Ison 2010, p. 105). Technologies becomes a surrogate for the values of its designers and subsequent opportunities for revision of such values is limited by the extent to which social mores can be challenged. Ison (2010) recognises social technologies in the mediating devices administering the way humans interact with their environment such as “‘cost-benefit analysis’, ‘white papers’, ‘public inquiries’, ‘carbon emission schemes’, ‘environmental management schemes’, ‘regulatory impact assessment’… the list is seemingly endless.” (Ison 2010, p. 105)

Furthermore social technologies are not benign, according to Ison “Sometimes they are beneficial and facilitate effective practices like creating road rules that minimise accidents. Sometimes they incorporate understandings that, experience shows, were inappropriate in the first place or that, on reflection, are no longer valid.” (2010, p. 5). This historically embedded nature of social technologies means that “Social technologies are distinct from artefacts such as a hammer or a computer considered in isolation, which is what we usually think about when technology is mentioned. Social technologies are characterised by a set of relationships in which the technology plays a mediating role just as the document template does in Figure 1.1.” (2010, p. 6)
By recognising the historical nature of social technologies a practitioner may be better equipped to challenge their relevance and applicability to current circumstances. “Based on the distinctions made in the situation, the practitioner can probe, or construct, the history of a situation thus becoming aware of how social technologies have reified understandings at earlier historical moments.” (Ison 2010, p. 93). It is in this context that much of what we do to accommodate or adapt with respect to climate change will depend on what frameworks we use to situate our understanding. “Climate change, through systemic effects associated with factors such as rising energy costs, technology failures associated with increasing temperatures and increased hurricane frequency may challenge the ongoing viability of the forms of human activity that have evolved in [Victoria]. In future people may no longer be able to live as they have due to breakdown of the people-technology relationship.” (Ison 2010, p. 104)

This research aims to develop and test a systemic and adaptive framework for CCA research governance as a social technology for use in the Department of Primary Industries with its various research stakeholders including communities, industries and other areas of government. Rather than look at the end product of knowledge development processes this research proposes starting from a perspective of research framing as critical to the way knowledge processes emerge and shape the development of social technologies for adaptation. In addition it uses this basis of social construction in science and technology development as a means for developing techniques for monitoring and evaluation of the effects of social technologies through better or worse performances and trajectories of sustainable livelihoods in the transition towards a low carbon economy and society.

This research will engage with and build on international developments in social learning and citizen engagement in scientific research. It will develop areas of possibility for
innovation in research governance and institutional adaptation through the design of a systemic and adaptive framework for CCA research practice. Furthermore, it will contribute to organisational learning by building critical capacity of citizens in science and technology assessment in an Australian context of climate change adaptation. Through a focus on community-based adaptation and evaluation of self-organisation it will add understanding to the role of governance in science and technology development in a climate change world. By entering a new phase of horizontal practice through a focus on processes of design, action, and learning it will contribute to greater accountability for change (monitoring) based on actions taken within a systemic and adaptive governance framework.

(ii) Background

Climate change projections are based on Intergovernmental Panel for Climate Change (IPCC) scenarios which were generated on a set of assumptions about demographics, development, science and technology. These are assumptions that can potentially be intervened on to alter the understanding of climate change impacts and development of adaptive responses. In other words the underlying assumptions are that which set the conditions for change and frame the set of possible adaptation responses. Nevertheless current climate projections based on existing trends will mean that some vulnerable areas are undoubtedly going to suffer losses. At this point in time this necessitates the questions of how we can be better informed to pre-empt and avert the worst of consequences for those most vulnerable to climate change impacts. However there is also an opportunity for feedback upon those assumptions underpinning climate projections, in this case, based on the Victorian experience of coming to terms with change. While the assumptions underpinning the climate projections are broadly based analysis of change a more nuanced understanding of relational dynamics at a higher resolution of change may produce some surprises. This proposal invites consideration on what can be learnt from local processes of knowledge development to investigate the social dynamics in CCA knowledge production and informed action that leads to better or worse trajectories and performances of sustainable livelihoods.

Climate change is conceived as but one of a range of ‘wicked problems’ confronting governing institutions in areas of health care, indigenous welfare and other social issues. As a result different approaches to tackling seemingly intractable problem are being considered at the highest levels of governance in advanced liberal democracies (e.g. APSC 2007; RCEP 2007). Such problems are seen as requiring innovative ways of finding solutions with the support of business, civil society and community organisations in effort to improve what seem to be a set of messy situations with multiple causality and complex effects. Furthermore there is increasing importance attached to recognising those most vulnerable and including awareness of citizenship issues in realising climate change as coming to terms with scarcity and developing greater efficiencies and practical responses to the multifunctional use of natural resources. This has led some to suggest that the skills and capability in leadership and organisation needs to break with traditions based on control and certainty and become more responsive to opportunities for social and technological innovation in conjunction with climate change uncertainties (Woodhill 2010; RCEP 2010).

(iii) Significance and Innovation

The Department of Primary Industries in Victoria, as Victoria’s largest public service employer of scientists, is well positioned to provide technical support in understanding and modelling the impacts of climate change projections. However the ability for the department to assist local, regional and state decisions makers in understanding impact and making choices for adaptation requires a new set of expertise and professional skills
in collaborative research design. Recent developments in Systems Thinking and Social and Technology Studies can provide that expertise in working with diverse stakeholders interests and accommodating complexity and uncertainty in research and policy design. DPI is well positioning to play a leadership role within the science-policy community that links rural and regional development to food and fibre production in agriculture and forestry. However, in recognising a horizontal governance approach, this requires capability to accommodate new relations in research design in moving towards governance of adaptive and systemic sustainable development and community wellbeing. This research recognises the importance of relationships in effective and efficient organisation to build collaborative and institutional capability for systemic and adaptive climate change adaptation. From this perspective climate change represents a valuable opportunity for the development of new research relationships between DPI and its other governance stakeholders that can also build on growing momentum to include citizens in the design and evaluation of research (Jasanoff 2007; Fischer 2009; Glenna et al 2010).

From a broader perspective of science policy issues there is a growing need to connect up scientific research with policy and public values to enable fuller interpretation and integration of facts and values in research inquiry and impact assessment (Nowtony 2007; Boxelaar et al 2006; Wiseman 2006). However there are issues in enabling this where there is limited capacity for organisational learning and fundamental conceptual constraints to accommodating uncertainty in scientific analysis of complex or messy situations embracing multiple perspectives and interests (Ison 2010; Allan and Curtis 2005). Many have come to recognise the changing role of government as a facilitator of change in a more complex organisation of multifunctional systems (Espinoza 2006; Folke et al 2005; Wilson 2007; Lovell et al 2010). Some analysts have begun to see agriculture is seen as part of a wider integration of social and natural environments and the systems we recognise that they embed (Altieri 1989; Conway 1987).

Governance institutions require new capabilities and skills in leadership and learning that rely on open spaces for conversations to reflect and learn from experience on appropriate design in governance frameworks (Woodhill 2010; Folke et al 2005). Effecting new accounting approaches that build on growing awareness of the consequences of governance actions with the capability of monitoring and evaluating the effects of choices (Thompson and Scoones 2009; Ison 2010). This awareness involves a language of viability and learning in which development interventions move towards a democracy of responsibility and issue ownership to foster autonomy of self-regulating 'local' societies into a complex integrated system in which performances and trajectories of sustainable livelihoods can be evaluated against culturally desirable and feasible change. Recognising questions of identity and purpose in relation to an expanding and differentiating knowledge of climate impacts and adaptation choices and their effects that can cope with environmental pressure and change and that increase the possibility and capacity for sustainable livelihoods of future generations.

Research into adaptive natural resource management has shown deeply entrenched institutions that prevent the realisation of adaptive capacity within government as evidenced in the kinds of metaphors used in resource management practice (Allan and Curtis 2005). The disciplines of management practice are revealed in the language of ‘targets’ and so on which direct away from incentives for learning and developing adaptive capacity (Ison 2010). In response to these limitations in facilitating organisational learning and institutional capacity for adaptation, Ison (2010) recognises there is an urgent priority for thinking systemically and building reflexive systems practice to manage co-evolutionary dynamic between humans and the biosphere). Others have also signalled to the need for open spaces of collaboration to better reflect on the conditions through which out current institutions have formed and to better articulate and design possible futures in which diverse, viable human and natural environments co-exist (Collins and
Ison 2007; Brown and Issacs 2001; Norgaard 2004; Senge and Schirmer 2006). We need to address questions of why we have failed to institutionalise adaptive and systemic thinking in organisational practice (Ison 2010; Fischer 2009) to embraced thinking about social organisations and the natural environments they co-evolve with (Ison 2010; Kallis and Norgaard 2009).
References


Appendices

Appendix 10.1 Schedule from Contract between DPI and Monash

Statement of Purpose

To contribute to the development and application of Systemic Science in the Victorian Department of Primary Industries (DPI), in particular through the participation in relevant departmental projects and training.

Activities

1. Conceptual Framing, Methodological Advice and Implementation

(i) In collaboration with selected departmental staff, and recognising current DPI climate change adaptation research, develop a systemic framework of theory and praxis, including possible methods and techniques, to assess potential climate change impacts and adaptation actions on agriculture (including forestry) systems at regional and state-wide levels. The systemic framework will be initially tested in the Goulburn-Broken Region of Victoria.

(ii) Test and adapt stakeholder engagement processes, and design new processes as required, based on Systemic Science and social learning principles, for the realisation of the framework described in (1.i).

2. Capability Building in Systemic Science

(i) Work with others in DPI to research and develop an effective community of practice in Systems Science – produce one journal paper at the end of 12 months;

(ii) Support DPI staff in situating DPI’s Systems Science initiative at the forefront of innovation at State, National and International levels, by providing targeted mentoring, public lectures and guidance in the preparation of papers for publications in refereed journals.

3. External Linkages and Funding

(i) Contribute to establishing new, and strengthen existing, links with key Australian and international organisations involved in Systems Science initiatives on climate change, water resource planning, and rural livelihood and farming systems transformation (e.g.; Commonwealth Department of Climate Change, Australia; Open University, UK; Tyndall Centre, University of East Anglia, UK; INRA, France; Wageningen University Research, the Netherlands).

(ii) Collaborate with DPI in the preparation of (at least) one external funding proposal during the year such as an ARC Linkage Grant, or European Framework 7 Project Grant.
### Appendix 10.2 List of contributions made by the Monash team over the contract period

<table>
<thead>
<tr>
<th>Date (2009/10)</th>
<th>Activity</th>
<th>Monash Participants</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>21st May</td>
<td>W’shop for DPI</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>27th May</td>
<td>Planning meeting</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>15th June</td>
<td>Meeting – G Mitchell</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>18th June</td>
<td>Meeting RF &amp; SM re CoP</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>June-July</td>
<td>Interviews with FFSRD managers</td>
<td>Josh Floyd</td>
<td></td>
</tr>
<tr>
<td>8th July</td>
<td>Ditto</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>22nd July</td>
<td>Mentoring</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>29th July</td>
<td>Meeting re CoPs research</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>12th August</td>
<td>W’shop for FFSRD managers</td>
<td>Ray Ison; Josh Floyd;</td>
<td></td>
</tr>
<tr>
<td>2nd Sept</td>
<td>Meeting – V Sposito</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>14th Sept</td>
<td>Meeting – R Faggian, D Griffin</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>16th Sept</td>
<td>Meeting – R Faggian Policy and Strategy Group</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>25th Sept</td>
<td>Meeting – S McArdle &amp; B Iaquinto</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>9th Oct</td>
<td>Wellington Shire Meeting – V Sposito, R Faggian</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>12th Oct</td>
<td>DPCD Sharing systems learning’s – C Leighton</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>16th October</td>
<td>Planning event</td>
<td>Ray Ison; Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>19th Oct</td>
<td>Meeting DPI – V Sposito R Faggian</td>
<td>Andrea Grant; Ray Ison</td>
<td></td>
</tr>
<tr>
<td>21st October</td>
<td>Meeting –CC research</td>
<td>Ray Ison; Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>22nd October</td>
<td>Meeting re CoP research</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>30th October</td>
<td>Meeting – G Mitchell</td>
<td>Ray Ison</td>
<td></td>
</tr>
<tr>
<td>6th Nov</td>
<td>Meeting R Faggian D Anderson</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>17th November</td>
<td>Meeting – Wellington Shire and DPI</td>
<td>Ray Ison; Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>17th Nov</td>
<td>DPCD Sharing systems learning’s – C Leighton</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>1st Dec</td>
<td>DPCD Sharing systems learning’s – C Leighton</td>
<td>Andrea Grant</td>
<td></td>
</tr>
<tr>
<td>4th Dec</td>
<td>Meeting</td>
<td>R Ison; A Grant</td>
<td></td>
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<td>12&lt;sup&gt;th&lt;/sup&gt; Mar</td>
<td>Meeting – Monash research officer – P Jones</td>
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<td>R. Bawden; R. Ison; Strategic Discussion – place of systems in DPI</td>
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<td>23rd August</td>
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<td>Ray Ison; Andrea Grant; Final Report.</td>
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Appendix 10.3. ‘Framing’ – a Review

by

Ben Iaquinto

Frames are used to negotiate the complexity of the world by determining what requires attention and what can be ignored. A frame is the context through which a person interprets the world. A person’s frame is also known as his or her perception, perspective, worldview, mental model, script or schema (Isendahl et al 2009; Dewulf et al 2009).

A frame is a sense-making apparatus, a filtering mechanism deployed to reduce the amount of sensory input received by an individual during an experience. A person’s frame is shaped by their particular experiences, culture, gender, education, personality, mood and a myriad of other causes. As frames create and are caused by information processing shortcuts, they are not the same as beliefs (Kaufman and Smith 1999). The study of frames is known as frame analysis, and is commonly used in empirical work on social policy debates (Creed et al 2002). The aim of this essay is to provide a review of the academic literature on frame analysis with a specific focus on how frame analysis has been applied to environmental conflicts.

Kaufman and Smith (1999) make an interesting distinction between ‘adopting a frame’, which they see as an individual’s personal choice devoid of interactional consequences and ‘framing’, which to them is the calculated construction of a frame for oneself with the intention of benefiting a specific audience, such as the public, a constituency or during negotiations. They go on to explain that reframing is the purposeful attempt to change someone else’s frame.

History of Frame Analysis

Frame analysis has been applied in the political science and communications literature (Entman 1993; Chong and Druckman 2007), in conflict and negotiation research (Agne 2007), in media analyses (Tuchman 1978), in policy debates (Schon and Rein 1994; Hoffman and Ventresca 1999), in organisational research (Creed et al 2002), and to understand environmental conflicts (Lewicki et al 2003).

One of the most widely known early studies of frame analysis was by Goffman (1974), who saw framing as a sense-making technique and explained how people use frames to organise and make sense of the multitude of stimuli encountered in everyday life. According to Creed et al (2002), later studies to build upon Goffman’s (1974) ideas retained the sense-making element of his work but incorporated it into examinations of how controversial social issues are framed. This new direction is largely reflected in the studies by Gamson (Gamson et al 1982; Gamson and Lasch 1983; Gamson and Modigliani 1989).

Other important work from that period includes Tuchman (1978), who considered news to be a frame and studied how news organisations help to determine the social construction of reality, and the work of Tversky and Kahneman (1981) and Kahneman and Tversky (1984) who were concerned with the application of frame analysis in understanding people’s decision-making processes.

Later studies include Zaller (1992), Entman (1993) and Levin et al (1998). Zaller (1992) investigated how political information and argumentation is converted into political opinions. Instead of using the word ‘frame’ to describe how people mentally arrange political information, he opts for ‘consideration’. Whereas Entman (1993) believed a
general theory of framing was lacking despite it being a widely applied term within the social sciences and humanities. He thus aimed to synthesise the disparate uses of the term via the discipline of communication. Levin et al (1998) thought it was not yet known how the framing of information in positive or negative ways influenced decision-making. They constructed a typology to distinguish between three different valence framing effects including Tversky and Kahneman’s (1981) risky choice framing effect, as well as attribute framing and goal framing.

In an influential study on framing, Schön and Rein (1994) explained that intractability of conflicting frames is based upon the diverging sense of ‘obviousness’ held by opposing sides in a dispute. They explained that when situations are framed, a transition occurs in the way people think about such situations. People go from describing facts to prescribing solutions and what should be done. The authors describe this as a “normative leap”, and caution that it is typically undertaken in such a way that so-called solutions to a problem will appear “graceful, compelling, even obvious” (Schön and Rein 1994:26). Therein lies the power of framing. When executed deftly, framing can be persuasive enough to trick people into believing a certain solution is the only logical way to deal with a particular issue. But the authors are not clear as to whether this “normative leap” is done intentionally or if it is the natural outcome that occurs when trying to convince others to agree with your viewpoint.

Schön and Rein (1994) explained their use of framing as quite similar to the work of sociology of knowledge proponents such as Mannheim (1974; 1974a). They believed their use of framing is “radically constructivist” (Schön and Rein 1994: 215), as described in the work of Jean Piaget (Piaget 1962), Nelson Goodman (Goodman 1978) and Ernst Von Glazersfeld (Von Glazersfeld 1985), amongst others. According to Schön and Rein (1994), their idea of framing differs from that of Tversky and Kahneman (1981) and Kahneman and Tversky (1984), who saw framing as differing propositions deployed to describe an identical problem, such as whether losses or gains are incurred as the consequence of choosing an investment. Another important distinction is that Tversky and Kahneman believe in an objective social world external to frames, whereas Schon and Rein do not (Schön and Rein 1994).

More influential work on framing has been conducted by Barbara Gray, who claimed it was the work of sociolinguists, psychologist and anthropologists such as Tannen (1979), Minsky (1975) and Bateson (1972), who shaped her ideas of framing and upon which her work is based (Gray and Putnam 2003). Whereas Schön and Rein (1994) were more concerned with framing in policy debates, Gray’s work is largely concerned with conflict framing in the context of environmental disputes (Gray 2003; Gray and Putnam 2003; Gray 2004) and mediation (Gray 2006). Gray’s knowledge of framing appears to have deepened through her collaborations with others on framing studies. For example, in Brummans et al (2008), they explain that conflict situations can be framed quite differently even amongst people from the same side, which goes against the conventional wisdom that frame differences exist only between disputants from opposing sides in a conflict. This more nuanced understanding of frames is less evident in Gray’s earlier work with Lewicki et al (2003). Then, in a more recent publication, Gray appears to have further diversified her understanding of framing through a “meta-paradigmatic approach” to framing in which various framing paradigms are investigated and similarities between each are noted (Dewulf et al 2009: 157).

A significant proportion of the framing literature examines the ways different environmental stakeholders frame resource issues. These include studies that examine the ways uncertainty is framed in water management practice (Isendahl et al 2010a; Isendahl et al 2010b; Isendahl et al 2009) how divergent frames impede natural resource management (Dewulf et al 2009) and environmental conflicts (Lewicki et al 2003;
Brummans et al 2008), and how consumers frame environmental action during their everyday practices (Barr and Gilg 2006). As there are many intractable environmental conflicts occurring throughout the world today, framing provides a means to better understand these conflicts and potentially resolve them (Putnam and Wondolleck 2003).

**Types of Frames**

Numerous types of frames are discussed in the literature, so this section will begin with a brief overview of some well-known frames before discussing in more detail frames that are common in environmental disputes as discussed in Lewicki et al (2003).

Schön and Rein (1994) distinguish between rhetorical frames and action frames. Rhetorical frames are those that are grounded within the arguments and narratives employed to persuade people during policy debates, whereas action frames are used to undertake policy practice (Schon and Rein 1994).

Risky choice is a form of framing that offers different levels of risk from a set of options, goal framing is where the consequences of a behaviour are framed, and attribute framing directs the framing towards a particular aspect of an event (Levin et al 1998).

Dewulf et al (2009) distinguished between cognitive framing and interactional framing, where cognitive framing are frames which are representations recalled from memory, and interactional framing focuses on the ways meaning is continually shaped via the interactions between people. These two types of framing can be neatly summarised as ‘between the ears’ (cognitive framing) and ‘between the noses’ (interactional framing) (Dewulf et al 2009).

Frames common to environmental disputes are identity frames, characterisation frames, conflict management frames, whole story frames, social control frames, power frames, risk frames and gain versus loss frames (Gray 2003).

**Identity Frames**

Conflicts are partly shaped by the identities of the disputants and identity frames are the ways participants in a conflict explain their own roles (Putnam and Peterson 2003). For example, Elliot and Hanke (2003) describe conflicts over industrial pollution within the communities of Chattanooga, Tennessee and Lock Haven, Pennsylvania, where the identity frames held by residents in each town reflected their identities as either victims or defenders of justice, whereas the public officials and industrialists in conflict with the residents saw themselves as rational experts (Elliot and Hanke 2003). Because identity is so personal, challenging an individual’s identity frame is likely to be experienced by that individual as a personal attack, therefore identity frames increase the intractability of conflicts by reinforcing the disparate identity frames of the disputants (Gardner and Burgess 2003; Elliot and Hanke 2003).

**Characterisation Frames**

Characterisation frames also increase the intractability of conflicts through negative characterisations of the opponents (Gardner and Burgess 2003). Negative characterisations result in people being unable to take opposing views seriously, as these views have been belittled and stereotyped to such an extent that the possibility of mutual understanding and progressive dialogue is severely diminished (Gardner and Burgess 2003). To summarise, identity frames are how people see themselves while characterisation frames are how people see their opponents.
Conflict Management Frames

This is the general term given to numerous frames that shape how people deal with conflict (Gray 2003). Some conflict management frames include fact-finding, joint problem-solving, adjudication, appeal to market economy and avoidance/passivity (Gray 2003). This is important because the outcomes of public policy are shaped by the types of conflict management frames people adopt (Gardner and Burgess 2003).

Whole Story Frames

The utility of whole story frames is their ability to uncover what each disputant believes the main issues of a conflict are (Kaufman and Momen 2003). They do this by providing insights into how disputants personally summarise a conflict (Gray 2003).

Social Control Frames

Social control frames refer to an individual’s preference for how society should be managed and controlled (Peterson 2003). Social control frames are predominantly about ethics and thus shape views on how power is exercised in a society, who has access to such power and how citizens are penalised for disobeying the rules of their society (Peterson 2003). Peterson (2003) believed the importance of social control frames is due to the critical role they play in the selection of conflict management options.

Power Frames

Power frames are the ways individuals exert influence within a conflict. They are also the ways people who are part of a conflict understand the ways other disputants exert influence. Gray (2003) identifies numerous types of power frames including authority/positional, personal, resources, moral/righteous and force/threat.

Risk Frames

Within environmental conflicts, risk frames pertain to the perceived degree of risk posed by environmental hazards, which can vary greatly between disputants (Gray 2003). Hanke et al (2003) outline three different types of risk frames: ‘sponsors’ who focus on predicted outcomes, ‘guardians’ who are concerned with the potential for cataclysmic events, while ‘preservationists’ are a combination of the previous two.

Gain versus Loss Frames

These frames are how people interpret actions taken by others to be detrimental or beneficial to themselves or others (Gray 2003). This is important as the study by Tversky and Kahneman (1981) famously demonstrated how framing an event as either a loss or a gain greatly shapes the level of risk people are willing to accept.

Frame Differences

Coleman (2004) explains the worth in understanding frames is due to the dependence on metaphors in human understandings of the world. Using the metaphor of a ‘road map’ himself, Coleman (2004) explains how frames act as such by guiding the information processing aspects of human thought. He asserts that people have a tendency to disregard utterly any information which does not correspond to the frames they currently have. Yet he argues this tendency is because frames can be physically present in the synapses and neurons of our brains, which apparently is “one of the fundamental findings of cognitive science” (Coleman 2004: 199). I don’t totally agree with this but in any case I
am aware of the tendency he discusses and agree that it makes conflicts created by divergent frames quite tricky to resolve.

Dewulf et al (2005) describe a number of situations that cause frame differences, from the different ways natural resources are used amongst various actors such as tourist agencies, industries and farmers, to the range of frames created by different scientific disciplines. Therefore, interpretations of events and the solutions offered to solve problems are not neutral, as they are shaped by the personal frames of individuals (Isendahl et al 2009). Acknowledging the diversity of frames and overcoming their differences is critical for collective problem-solving (Isendahl et al 2010a).

Certain types of frames are more conducive to resolving conflicts than others. For instance, Kaufman and Smith (1999) explained that outcome frames, which focus on people’s specific positions, are unlikely to result in resolution of conflicts as they encourage people to reinforce their own stances without trying to understand differing perspectives. Whereas aspiration frames focus on a valued end state which could encourage disputants to work together, as it may reveal their differences are only on the means to achieve what is actually a similar goal (Kaufman and Smith 1999). Another insight into how particular frames shape the outcomes of conflicts explains how conflict intractability and framing are “reflexively linked” (Putnam and Wondolleck 2003: 55). This was because intractability strengthens identity and characterisation frames and vice versa, but also because intractability causes people to act and actions are influenced, justified and directed by frames (Putnam and Wondolleck 2003).

**Changing Frames – theory**

Offering win-win scenarios, providing superordinate goals and reframing conflicts are in themselves inadequate for addressing complex intractable conflicts, according to Putnam and Wondolleck (2003: 56-57). Instead, they advocate three potential avenues for resolving intractability – “internal shifts”, “responses to external changes” and “framing and transformation”, which are discussed below.

Internal shifts change the intractability of a conflict by altering what is intractable. For example, in a property rights conflict, stakeholders may reframe their position from one that prohibits any regulation of water or land to one that permits community regulation of water or land. As Putnam and Wondolleck (2003) explain, the reframing is from a rights frame to a social control frame, which shifts the conflict into a more tractable position.

In contrast to internal shifts there are responses to external changes which can cause frame convergence as disputants respond to a catastrophic event such as a bushfire or flood by recognising they must work together to overcome this new challenge (Putnam and Wondolleck 2003). These are cases where both sides realise the hazards of continued conflict, such as when the federal government threatens to intervene in a localised environmental dispute (Putnam and Wondolleck 2003).

Finally, there is framing and transformation in which transformation of conflicts towards resolution is accomplished through a reframing process that incorporates “dialogue”, “sustainable reconciliation” and “transcendent discourse” (Putnam and Wondolleck 2003:57). Dialogue encourages mutual understandings of the divergent frames that helped create the conflict, sustainable reconciliation requires disputants to acknowledge misdeeds they have committed and to forgive one another for them, while transcendent discourse encourages the disputants to critically evaluate their own assumptions about knowledge, meaning and values (Putnam and Wondolleck 2003). The aim is for the different parties to extend their values and social systems to reach mutual understandings.
In conflict negotiations, Kaufman and Smith (1999) maintain that the best chance for achieving consensus between opposing parties is to reframe how antagonists see their conflict. This is because altering resource distribution and/or behaviour is comparatively much more difficult (Kaufman and Smith 1999). Meanwhile, Elliot and Hanke (2003) discovered that by altering identity frames or conflict management frames, changes in communication occur which alter characterization frames, listening and trust. A positive form of communication was seen to result from more inclusive and broad forms of identity frames (Elliot and Hanke 2003).

Dewulf et al (2004) use the term “frame configuration” to describe the variety of different frames people bring to an issue (Dewulf et al 2004). They explain how frame differences are more likely to be resolved when the number of different frames (the frame configuration) is smaller. A more heterogeneous frame configuration is likely to increase confusion amongst participants and hinder efforts to overcome frame differences. According to Dewulf et al (2004: 191), a low frame configuration has a higher chance of resolving frame differences, and they advocate “tuning the different frames and connecting the different actors into a mutually acceptable relation” to resolve frame differences that have hampered natural resource management. Yet the authors are not clear on the form this “tuning” should take.

**Changing Frames – examples**

Bryan and Wondolleck (2003) describe a conflict in the northwest USA that has been continuing for about thirty years. In the ‘timber wars’, extractive users of forests (loggers) are in conflict with non-extractive users of forests (environmentalists). The conflict increased during the eighties when left-wing urban professionals moved into the area while the Reagan administration increased logging. By 1992 it appeared that environmentalists had been so successful at fighting the timber industry, timber-dependent communities, such as the town of Quincy, California, were suffering. This caused Bill Coates, a Republican, and Tom Nelson, a timber-industry representative - two long-time proponents of the timber industry – to visit Michael Jackson, a local environmental attorney and member of the local environmental group Friends of Plumas Wilderness, to propose a forest plan environmentalists had unsuccessfully tried to implement in 1986. As all three men wanted community stability and believed the US Forest Service was part of the problem, this made some consensus possible and led to the formation of the “Community Stability Proposal”. This protected old-growth forests and trees adjacent to waterways but still permitted logging in certain areas and restored traditional levels of timber harvesting in certain areas around Quincy.

Frames were changed in this example because both sides were able to see the bigger picture – maintaining community stability, which resulted in a shift towards more inclusive identity frames, where both sides began to speak of “we” and “us” when discussing loggers and environmentalists alike, as the conflict was reframed away from the conventional “owls vs jobs” frame towards a “community stability and forest health” frame. Moreover, the antagonism both sides felt towards the US Forest Service fostered cooperation. While this conflict is still not completely resolved, it elucidates some of the characteristics necessary to shift an intractable conflict in a more tractable direction.

In conclusion, it is evident that frame analysis has been taken up by scholars in numerous disciplines and applied to a variety of situations. In the context of environmental conflicts, however, there appears to be an over-reliance on the work of scholars Gray, Putnam, Lewicki, Isendahl, Dewulf and Pahl-Wostl. Nevertheless the output of these researchers is sufficient to provide a thorough understanding of intractable environmental conflicts caused by divergent frames.
Appendix 10.4 Sources of data

Table 1: Documents reviewed

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<td>Department of Primary Industries Agriculture and Fisheries Four Year Strategy</td>
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<td>2009-2013</td>
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<td>Intergovernmental Panel on Climate Change Fourth Assessment Report (2007)</td>
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<td>Land and Water Australia’s National Climate Change Research Strategy (2007)</td>
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Table 2: Sources of Interview according to Codes

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Table 3: Participant observations

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<td>South West Adaptive Capacity Workshop</td>
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Table 4: Conversations incidental to observations

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<td>External non-government site</td>
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Appendix 10.5a: Interview questions

1. Brief description of what you do and who are your main stakeholders?

2. How in your position as research director/manager able to make a contribution to climate change knowledge?

3. What kind of threat do you think climate change poses to Victorians?

4. What are the different ways climate change is conceived of/conceptualised in the types of research activity you’re associated with?

5. How can and for whom will climate change research make a difference?

6. How are different conceptualisations of climate change assessed/valued by your stakeholders?

7. What does climate change research actually look like on the ground?

8. Is current research activity linked up in any way, and how? If not, why do you think it fails to be connected?

9. What type of barriers do you think exits for research to make a difference on the ground?

10. Anything else you think is important to this discussion?

Appendix 10.5b: Example of policy responses

Drivers of policy include such things as “strong growth”, “thriving innovation and ‘quality’ jobs” and “protecting the environment for future generations”. Drivers and (strategic) research direction are also viewed here from the perspective of systems thinking as the framing of issues or ‘problem ownership’.

Constraints or limitations include, e.g., “global financial uncertainty”, “significant new competition from developing countries”, and “climate change and emissions trading”. Constraints affecting the ability to act are viewed as ‘coupling’ of the governing system to its environment.

Competencies and skills are those capabilities encouraged as required and also seen here as contributing to ‘boundary maintenance’ of the governing system. They include, e.g., “efficient use of natural resources” and “protecting the environment for future generations”.
Appendix 10.6 Russell and Ison’s guide to conducting a systemic inquiry

Tasks
- Agreeing on the essential participants (the key stakeholders)
- A ‘system’ is generated which has been determined by the main issues of concern to the key stakeholders
- Collection of sufficient empirical data so as to establish the existence of specified events/experiences
- Determining the boundaries of the system (conceptual, geographical, etc)

First-order processes
- Invite relevant parties to state their interest in a particular event/experience
- The system is determined by the ‘problem’ not the problem being determined by the system
- Generation of patterns of data over time
- To incorporate data from the bio-physical and the psycho-social domain in determining systems boundaries

Skills
- Ability to identify parties with a particular stake in an outcome (e.g. resource providers; users of outcomes; producers of outcome)
- Group process skills couples with outcome-oriented skills
- Ability to recognise the key categories of data required and requisite skills to collect and quantify data
- Ability to successfully invite participants to offer narrative data via social technologies (e.g. semi-structured interviews; focus groups)

Potential pitfalls
- To equally involve stakeholder groups that historically have exercised little influence on how particular decisions are made
- That preconceived ideas of what constitutes the ‘problem’ will hinder a reframing of what constitutes an actionable problem
- That easily quantifiable data will be judged as being superior to less easily quantifiable data (e.g. value statements; emotional responses)
- To favour the generation of a dominant bio-physical system over a ‘human activity system’ (Ison and Russell’s 2000, p. 210)
Appendix 10.7 Conceptual models of CCA research

10.7.1 Comparative conceptualisation of research

Some of the key differences between these conceptual models are worth noting. These include responding to biophysical changes in the environment including understanding species-environment interactions; human activities and how they have been constructed in relation to these environmental changes, not just in production but consumption; and the policy platforms and practices which are being encouraged by government including contradictions in these between participants.

Characterisations of three groups of interview help in configuring a boundary for the environment in which CCA research operates. This comprises the views of (i) research managers in FFSR, (ii) internal DPI stakeholders in research, and (iii) external government stakeholders. There are some contrasting perspectives to situate the different interview comments and conceptual models of CCA research.

The first and second group were within the DPI and therefore were more likely to represent an internal view and culture of the organisation, while the second group represent a view of government and research need more broadly. There were distinct differences in research conceptualisation between these two groups. The third group offers an external perspective of other regional and rural community and environment dynamics that impact the way CCA research might realise the growth and development of agriculture and forestry in alignment with other areas of government. This view also mediates the framing of research between DPI and other areas of government and research as the arm of interest in practice change.

(i) Internal DPI perspectives

In this group research was varyingly conceptualised as: supplying the ‘fodder’ for policy development; finding a better ‘widget’ for improved productivity or efficiency; understanding the upstream and downstream impacts of research outputs; seeing the big questions (underlying causes) in a narrow field rather than a big field (complex interactions); trying to predict and anticipate what might happen in the future.

“...we supply the fodder for policy development but we don’t comment on policy, we supply the technical input or information or knowledge that they need to make policy decisions.” (M003)

“...we’re finding with climate change you can’t, it’s not a simple we’ll have a better widget and we fix up the job the widget does, it’s all the downstream and upstream impacts that that can have, and so it’s increasingly complex that one thing leads to another to another to another.” (M006)

“...whereas the dilemma for all the scientists is they get close to the work and they’ve been following an area of work for a number of years, they can see the big questions in a narrow field, rather than the big questions in a big field ... not many of us that’ve got that ability to be able to see what are the big questions that we have to answer in the main game. But part of the question I’ve got about our approach at present is have we got that robust framework that then helps identify the priorities.” (M007)

“...what we are doing, trying to predict, anticipate what might happen, getting the message across to people who may not necessarily believe that that’s happening. I mean a lot of farmers believe it’s variability, they’re not sure that it’s climate change.” (M011)

(ii) Internal DPI but external FFSR

The stakeholders within DPI had different conceptualisation of research as: trying to bring all the components together; dealing with the belief that climate will swing back; influencing
people that are in control of the policy levers; and making a purposeful case for evidence-based policy making.

“We’re trying to bring all of those together, the latest science and policy in a context that piece them all together. In the climate things my argument has been that that has been missing.” (S009)

“...a lot of them aren’t believers in climate change being a permanent and consistent trend, but they will talk quite readily about the fact that the climate has changed in the last ten-fifteen years, but in their heart they believe that it might swing back again.” (S010)

“...therefore our role has to be got, rather than seeking to control them, so there’s more influence with people who are in control of [the levers] and make sure they’re aware of the challenges for our sector... [and] use the information that we can gather through our research to influence them and to be able to make and make a purposeful, that’s a very popular word, a purposeful argument or case, so this is pretty much your evidence-based policy making.” (S002)

(iii) External DPI but internal government
This group conceptualised research as: the whole relationship in dealing with the daily economy and consumerism; understanding climate change as something that has to be dealt with but can’t really be managed.

“...looking at our sort of whole relationship of how we sort of deal in our daily economy and consumerism. And it's like the food situation. You buy the cheapest things at the supermarket, the home brand stuff, is all from either Brazil or Denmark and things like that.” (S205)

“How do I put it? It's like a sinister threat. It's something that uncontrollable: something that we have to deal with but we can't really manage. That's the standard response. So we kind of bank it in: I use the word external a few times. ... We bank it in to this uncontrollable threat. So far, there have been some good policies being developed now, as being much cleverer in terms of how it's trying to set government. I even use the word government response. So it's always something that we have to react to.” (S008)

The diversity captured here provides a view of internal FFSR management perspectives through quite distinct differences in concepts as technical policy advice, technological productivity improvements, impacts of improvements, and anticipating future events. On the other the internal stakeholders sought integration of research, better means for coping with denial, and influencing decision makers with evidence of impacts. Those with an external stakeholding conceptualised research through a wider social responsibility in which greater capacity for action could be built for transforming to a low carbon economy through wider stakeholder and community engagement, and coming to terms with unpredictable and uncontrollable risks by building adaptive capability for response in a dynamic environment.

10.7.2 A rich picture in conceptualising CCA research
A complex picture of participants’ inputs through interview reflected the situation as an unstructured system of practice or ‘rich picture’ (Figure 10.1). Efforts in analysis have been to configure this somewhat complicated situation into a structured model for debate of what constitutes a desirable and culturally feasible ‘system of inquiry’.

This was achieved by sorting out what people are doing, how they are doing it and why a model, or models, of CCA research as a ‘system of inquiry’ is starting to emerge. Initially as a means to start to examine how research is ‘put together’ interviews were considered for
some of the different types of ‘model’ participants used to construct their view of CCA research.

Figure 10.1 A rich picture of participants’ expression of the situation

10.7.3 Comparative conceptual models

Conceptual models are useful to look back on the wider discourse and policy response to climate change and to consider how these findings on practice interact with the policy context. They provide a means for opening up critique on the way research activity is conceptualised and to define possible areas for improvement.

1) The first type represents linear rationality such as a decision tree or casual model used to support decisions through scientific analysis. This generates a particular framing of the biophysical world, e.g., plant- or animal-environment interactions and scientific interventions to engineer better climate and food production outcomes.

2) The second type of conceptual models was that mobilising metaphor as a means to interpret change, for example viewing farming as an ‘opportunity system’ or ‘improving literacy’ on climate science. This translated an awareness of the environment, in this case the market or climate, to inform practical action. For example where constraints led to new views of opportunity or where a more informed reading of environment can lead to better production planning.

3) The third set of models represents a policy construct such as agenda matching, action accountability and new conceptualisations oriented towards social action. This provides a set of different framings through which purposeful action is directed.

3a) Agenda matching represents climate change as one of many policy agendas that those involved in government research had to respond to.
3b) Action accountability represents an accountability function for measuring returns for investment based on monitoring and evaluating the impact of programs implemented.

3c) New conceptualisations represents a policy development process that included a wider range of stakeholders, as end-users or up-takers, in research design.

It is notable that of these perspectives there are two distinct views of research as involving the systemic interactions between species and environment. The first instance develops on existing knowledge about plant and animal physiology and how that interacts with climate. The second also addresses human activity, e.g., through daily existence and consumerism. From this are two branches of approach roughly configured by internal and external perspectives: on the one hand seeking to reduce complexity to support decision making; and on the other using uncertainty as a means to explore different possible relationship to support a desirable future. One stream of activity is through bringing together new types of research design and development; and on the other in creating a view of how government can become more accountable for its policy interventions and new technological outputs. These perspectives open the possibility for viewing feedback from actual changes on the ground on the efficacy of actions as return for investment.

These models and the rest of the material gathered provide a baseline for developing an understanding of the different purposes of research activity and building a framework for research management practice. In the first instance it is noted that these concepts may look familiar as different segments of governing activity in policy design, research and development. Figure 10.2 represents an abstraction of these ‘models’ into a conceptual diagram for each linking the biophysical world to the socio-cultural world via farming practices. It suggests a model in which the development and design of scientific interventions in farming practice is situated against the policy discourse of social action in which research capability is realised. The wider governing context of CCA research in the socio-cultural model shows the two other ‘policy discourses’ of social action through new conceptualisations and action accountability. These are the two dimensions of external stakeholders’ views in planning and community development, and sustainability and environment of knowledge need in which DPI may find a useful space to collaborate.

| Table 10.4: Summarised conceptual models of CCA research and their fields of action |
|---------------------------------|---------------------------------|-------------------------------|
| Type of action                  | Species and environment         | Human activity                |
| Rational action                 | Internal FFSR                   | Internal/ External DPI        |
| Practical action                | Internal DPI                    | Internal DPI                  |
| Social action                   | External DPI                    | Internal/ External DPI        |
Three conceptual models in research, practice and policy areas:

- **Biophysical world**
  - scientific analysis
  - linearity
  - decision
- **Practical action**
  - improved use of resources
- **Socio-cultural world**
  - policy discourse
  - making sense of different framings
  - purposeful actions
  - new conceptualisations
  - action accountability
  - agenda matching
  - policy development
  - programs implemented
  - policy agenda
  - stakeholder design
  - monitoring impact
  - research capability
  - social action
  - development function
  - accountability function
  - changing agency
  - research function
  - making sense of application
These two dimensions are worth discussing further. New conceptualisations represent the need to open up spaces for creative thinking and conceptualisation of research questions that can start to see the future as different from the past. They represent the opportunity to realise new research relationships and design elements that are different from the tradition of policy and research platforms. One example of this more open space for development of research inquiry was the interdisciplinary dialogue in a workshop between agriculture and energy on the possibility for carbon sequestration as a starting point for shaping different types of research questions. Action accountability is a discourse in which government becomes more aware of the effects of interventions (e.g., regulatory, market or education) and programs in achieving what they set out to achieve. An example offered was of Landcare revegetation programs and whether they had been achieving what they set out to. A review of their efficacy, strengths and weaknesses could inform design and development of future programs. This could be translated, e.g., in the implementation of CCA programs someone takes responsibility for monitoring and evaluating whether they have made a difference and how, to improve the overall performance of CCA program design and delivery.

This figure offers a quite detailed representation and its explanation is contained with the experiences of people interviewed for this report. It opens the possibility for asking what value these contributions could add to the design of CCA research management practice. If given the opportunity to reflect on practice and ask how efforts at collaboration and integration, not just within DPI research teams, disciplines and divisions but across to other areas of government and new kinds of stakeholding in regions and communities, might be better directed. It is intended as an object for discussion with others in the organisation as well as those interviewed to ask whether it represents a valid framing of CCA as a ‘system of inquiry’. It is an attempt to summarise the DPI context of CCA research from the perspective of research management practitioners and some of FFSR stakeholdings. Otherwise a more detailed view of the ‘how’, ‘what’, ‘why’ of research as captured by participants interviewed, is provided in Chapter 7 (Table 7.2) detailing conceptual models of practice across all interviewees.

From this analysis a basis is formed of achieving a more dynamic view of the organisation working in three institutional spaces: in research, its development informing practice and the policy context. This view provides a basis for exploring how research is valued and linked up with the aim of ultimately moving towards culturally desirable and feasible change for the theory and praxis of CCA research.

We propose to reflect on practice by directing discussion towards developing a systemic and adaptive framework for research practice that recognises the contexts in which research is designed, developed and used and to what degree it can respond to changes in circumstances. However first we provide a response to the three key questions posed at the beginning of the research based primarily on participants interviews with some contrasting perspectives from observations and documents.
Appendix 10.8 Developing themes into analytical framework

10.8.1 Analytical framework

Four thematic areas were derived from this analysis comprising a set of discourses used by participants that illustrated different aspects of CCA research. The themes were generated out of the interview questions and could also be seen as part of the framework developing from the inquiry. This emergent framework is depicted Figure 10.3 in which analysis of key documents is linked with the interview analysis. Figure 10.3 represents the analytical model used to compare the findings from interviews with policy documents.

Table 10.1 outlines the classification of themes and discourses within them grounded in interview responses. These themes are classified as ‘knowledge needs’, ‘conceptual models’, ‘valuing research’ and ‘connecting research’. They were drawn directly from responses to research questions about the threat posed by climate change, conceptualising CCA research, stakeholders valuing of research and how research activity was linked-up. This framework was used to compare what people said about their practices against the guidance provided within policy and other key documents. These themes were selected over the others for containing the highest degree of diversity in responses.

Table 10.1 provides a summary of how respondents’ articulations are realised in practice. Table 10.2 provides a summary of drivers, constraints and competencies identified in the two strategy documents shaping DPI CCA research activities. This analysis considers which of these strategic elements are ‘taken up’ and what additional contribution interviews provide in understanding and framing CCA research. Thus it looks at which parts of the ‘system of inquiry’ realise strategic aims reconciling the logic of research purpose with the culture of research management practice.

Table 10.1: Summary of four thematic areas of research need, concepts, values and connection

<table>
<thead>
<tr>
<th>Threats posed expressed as knowledge needs</th>
<th>Conceptual ‘models’ of research activity</th>
<th>Perceptions of stakeholders valuing of research</th>
<th>Areas of linkage in connecting research activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retaining productivity and food security</td>
<td>Better understanding of environment interactions</td>
<td>Tangible influence on decision making and action</td>
<td>Formal and informal research networks</td>
</tr>
<tr>
<td>Resource competition and water shortages</td>
<td>Recognising socio-economic consequences</td>
<td>Focusing on ongoing production efficiencies</td>
<td>Recognition of new relationships through research</td>
</tr>
<tr>
<td>Mental health and community</td>
<td>Adapting to changing</td>
<td>Changing behaviour</td>
<td>Rewarding research feedback</td>
</tr>
</tbody>
</table>
The framing of research by drivers, constraints and competencies revealed a set of conditions in which there is a dynamic relationship between various strategic purposes of the documents. There are multiple drivers with interacting effects. Drivers of policy are typically internally derived purposeful governing actions based on policy advice such as increased productivity, improved health care or economic growth. However in the context of more dynamic market and climate environments there is a strong influence of external drivers. Under these conditions policy drivers might best be described as enacted within constraints of a more dynamic environment. Competencies are explored here as various means of enabling desired policy outcomes against environmental and other constraints. It is noted that ‘competencies’ is not the usual means of framing the development of government strategic goals. The discourse of competencies comes from management practice and is related to improving performance in relation to strategic outcomes rather than achieving goals. Essentially this places a different modus operandi on accountability measures.

This exercise in document analysis has demonstrated a high level of complexity in the external environment in which the DPI CCA research operates. It is no longer appropriate to think of problems and solutions as isolated from the contexts in which they are realised where the interactions between different drivers and constraints produce multiple effects and outcomes. In this analysis we found some drivers and associated competencies as given more significance in documents than others, e.g., the emphasis on production efficiencies and technological innovation takes some precedence over resource use efficiencies and market innovations. Table 10.2 outlines a range of drivers expressed within the strategic documents. It appears that a lot less of these are realised in the practice of CCA research within the DPI, giving a much narrower farming of drivers and competencies. However our inquiry into practice also demonstrates some areas that those involved in the development of the strategy documents may not be aware of or may have not necessarily embraced.

Table 10.2: Summary of drivers, constraints and competencies in FFS and FYS documents

<table>
<thead>
<tr>
<th>Drivers</th>
<th>Constraints</th>
<th>Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic/ productivity: Supporting strong growth in many markets through production efficiencies</td>
<td>Financial risk: Global financial uncertainty and uncertain prices</td>
<td>Production and resource use efficiencies: Efficient use of natural resources and growth capacity</td>
</tr>
<tr>
<td>Technological/ education: Thriving innovation and quality jobs</td>
<td>Market competition: Significant new competition from developing countries</td>
<td>Market and technological innovation: Innovation through quality jobs and thriving industries</td>
</tr>
</tbody>
</table>
At the time of reviewing documents, the strategic direction for CCA was governed by a business as usual framing with the two important investment actions acting as bookends around a greater complexity in the actions in-between. Boosting productivity through technologies and practice change and transport infrastructure to deliver produce to markets are investments that represent a continuation of economic development through primary production and trade. The other actions represent an increasingly complex environment in which primary industries are operating. New competencies are sought in areas of resource use efficiencies, market and technological innovations, supporting social values and environmental protection and social responsibility for understanding and managing risk.

These competencies are discussed with reference to the key drivers and constraints identified in Chapter 4 as relying on trends where drivers are the same as they were in the past. It is evident from the framing in documents that both the social and the natural situation has changed where environments are now more fluid and dynamic with less predictability in the interactions between underlying causes. The accommodation of greater pluralisation of values and uncertainty of knowledge and environments requires new strategies and approaches, e.g., for building greater awareness of change and recognising the emergence of new patterns in complex interactions between biophysical and sociocultural activities.

In this midway framing in the analysis our intention was to get some understanding of how practice might feedback some of the difficulties of addressing complex issues in CCA research for reflection and in realising the research framings offered in documents. However since this research began an annual update of the Four Year Strategy (2010) has been completed. The strategy has changed its focus from the role of government in achieving its desired actions from achieving excellence in corporate and business management to one of enabling departmental performance and developing partnership with industry, community and other stakeholders. At least that is how the text has reported new direction.

Drivers were defined as the pursuit of common goals for policy or strategy, in this case for agriculture. The key desirable actions were to deal with market and climate uncertainty by increasing tolerance of environmental turbulence. Some of the possibilities were framed as confronting new choice on diversifying varieties, redesigning pest management, etc. At the same time strategies are limited to on-farm decisions and not at the level of livelihood or socio-ecological resilience in which market relations are realised. Maintaining productivity at the forefront of activity was used in a way of supporting an individual capability to produce food for economic returns. This configured a corporate approach to agriculture.

The seven actions are proposed to help drive the sector through the challenges in which timber, biosecurity and land and biodiversity are also seen as relevant. It is worth noting that
drivers are not just framed as positive in the sense of potential gains but through an immediate uncertainty and future orientation of the strategy they are configured as climate and market uncertainty and risk in the sense of averting losses.

“While strong growth in many markets is expected, challenges including global financial uncertainty, significant new competition from developing countries, climate change and emissions trading, increased competition for natural resources, particularly water, rising concerns globally relating to food security, the changing social landscape, especially in rural areas, will also impact.” (Four Year Strategy 2009, p. 1)

Constraints are an important reference for the design and development of particular competencies. Constraints are described as a set of risks to ‘productive, competitive and sustainable’ agriculture. The challenge of uncertain market prices and demand, and extended drought and global market competition present as threats to reducing returns on investment. There are also direct business risks of water scarcity, labour shortages, resource competition and long term impacts of climate change that are framed as constraints on agricultural development. Consumer changing perceptions of risk and biosecurity and global development are seen as both constraint and opportunity through growing market opportunities against increased input costs. Scientific uncertainty is also framed as constraint where history is no longer a reliable guide to future. Uncertainty in relation to climate change is with potential impacts on food quality, lower yields, event damage, reduced water, heat stress, rainfall variability, animal welfare, etc.

Competencies are evident in characteristics such as building on agricultures resilient adaptability, including skills in recognising opportunities, e.g., in new markets for water and carbon. There are also competencies to be realised in efficiencies, innovation, environment protection and social responsibility driven by competitiveness, sustainability and changing values. Further competencies in the FYS of increasing wealth and wellbeing with the vision is its broadest sense as progress within a risk managed environment through greater resource use efficiencies and technological innovation.

“Enable transformation in Victoria’s primary and energy industries to sustainably increase wealth and wellbeing while protecting and enhancing safety, community, animal welfare and environment”(Four Year Strategy (2009 p.2)

It would seem that the policy direction is to be everything to everyone including corporate and business management approaches to risk and uncertainty that focuses on asset protection and wealth creation for the state as well as social and environmental values influencing farming practices. Yet this is said to underpin a whole-of-government strategy operating in a dynamic government environment reflecting a massive effort in document integration. However it is the rhetoric of joined-up government not the reality that was experienced in relation to CCA research. In reality a lot of resources are spent in document preparation and reading. There is not much of the social interaction planned for in managing collaborative and integrative forms of research required for innovation. The emphasis on document production is reflected in the condition that the document is framed as future oriented and a ‘rolling strategy’ that gets updated annually in response to a dynamic environment.

In the first annual review of the Four Year Strategy there is policy attention to increasing productivity and net value for growing market access, sustaining the natural resource base and protecting and enhancing community resources. However in the first annual review the focus shifts from business management to ‘enabling departmental performance’ and partnerships and engagement with industry, community and other stakeholders. What seems
important is that these processes cannot be assumed to occur as intended. Experience has shown that process involving diverse stakeholding and novel relationships require conditions for building trust, recognising and accommodating differences in subjectivity and worldview. In other words closer engagement requires a set of practices that existing management may not be equipped to coordinate. Furthermore some of the structures of linear management would be inappropriate for open and contingent decision contexts, where the outcome of discussions cannot be known in advance.

It is worth noting that the set of strategic documents refer to each other becoming a self-referencing system of program development. It can become an awkward situation in which no one is really challenging the legitimacy of frameworks in the documents. There is no ‘critical perspective’ to challenge whether they do what they set out to do. In some sense this results in a lack of overarching structure or framework which can accommodate the difference discourses of CCA to demonstrate that they are achieving what they set out to do. The documents themselves provide a set of divergently directed actions. Arguably they are focused on the importance of government being seen to be doing something rather than to be doing something that makes a difference to the lives of people who are confronted with uncertain and complex situations. This opens the question of how government does self-evaluate in relation to the environment in which it operates and what sort of system of efficacy and effectiveness guides DPI CCA research.

In addition, comments are worth noting on who ought to be involved in the dialogue proposed by the Climate Change Research Strategy for Primary Industries (CCRSPI) industries (Table 10.3) or individuals within them. Interviews surfaced issues where industries may not be the appropriate framing for research investment as indicated both by comments and observations that individuals are less committed to industry survival than they are to their own future. Therefore how can industries be supported in providing support to research inquiry where they might not be supported by individual choices into the future? This represents a highly charged and political context for research development and in the history of research management practice and stakeholding in which government has devolved funding responsibilities to industries. The complexity of the relationship between end-users and research by including industries as key mediators of knowledge development is something to be considered against the desire for dialogue in CCA research with a wider range of stakeholders and especially those that do not sit within the traditional industry networks.

Table 10.3: List of primary industry bodies contributing to CCRSPI

| Australian Egg Corporation Ltd |
| Australian Pork Ltd |
| Australian Wool Innovation Ltd |
| Cotton Research and Development Corporation |
| Dairy Australia |
| Fisheries Research and Development Corporation |
| Forest and Wood Products Australia |
| Grains Research and Development Corporation |
| Grape and Wine Research and Development Corporation |
| Horticulture Australia Ltd |
| Land & Water Australia |
| LiveCorp |
| Meat and Livestock Australia |
| Rural Industries Research and Development Corporation |
| Sugar Research and Development Corporation |

Source: Climate Change Research Strategy for Primary Industries (LWA 2008, p. 6)
Taking a step back from this structured document analysis has been useful to see what picture is being created. For example in exploring what relationship are emerging between policy discourses and research management practice and where they contradict or lie in tension with the past. These present opportunities for reconfiguring relationships in which innovation in energy, agriculture (including forestry), transport, infrastructure and development might flourish. However from the perspective of systems practice there is a need to create the conditions in which emergence can be analysed and its benefits and risks be considered as an active process of systems building. In this context government needs to become a more attuned and flexible developer of the kinds of social technologies designed to intervene on development pathways in a way that can contribute to the sustainability of livelihoods.

Figure 10.4 offers a model in which some aspects of the document analysis are integrated with interview findings to generate three areas in participants’ discourses of practice with the driver, constraints and competencies of documents. As an illustration of the exercise a simplification of drivers, constraints and competencies from the Four Year Strategy are used to map relationships between strategic documents and interviews discourses. In the analysis of interview participants’ discourses of practice three areas of interaction were found to offer new understanding to the feedback and interpretation of DPI’s CCA research. These were:

- belief systems and innovation opportunities;
- ‘strengthening’ the communication relationship; and
- rationalising immediate and longer term benefits.

These particular areas of competency, arising in observations and participants’ perceptions of practice, did not seem to have been captured by the strategic documents. In reflection these competencies formed a bridge between realising constraints in practice and enabling integration across key strategic drivers.

At the moment the discourse and framing of competencies is limited. There is an opportunity to reflect on what capability DPI is building within its researchers and stakeholders in becoming systemic and adaptive CCA researching system. Most of the attention is drawn to the continuation of production efficiencies with the new development of resource use efficiencies such as savings in irrigation infrastructure and knowledge of plant-water interactions. Our analysis has recognised other areas of competencies for learning and integration of differences in research disciplines, stakeholding interests and subjectivity. We also see an opening in terms of social capability for communicating knowledge and articulating need under conditions of uncertainty. This represent a significant shift from past knowledge needs and research framing in which there has been a linear projection of cause and effect actions.

At the outset of this inquiry we saw CCA research as a complex or ‘wicked’ problem in which linear causality was difficult if not impossible to locate. Thus we took to the approach of trying to understanding the complexity of the situation to better design a framework for CCA research capability and development. For example what happens when strong market growth declines or competitiveness drops off under turbulent conditions of global financial stability or extreme climate shocks? How does the system self-organise in response to environmental changes and challenges in which past institutions fail to serve the goals and changing knowledge needs of DPI.
Figure 10.4 Linking document and interview analysis into analytical framework
10.8.2 Belief systems and innovation opportunities

1) It seems that DPI’s CCA research is largely configured by convincing the majority that climate change is real, at least in the internal discussions of practice. The concern about people’s belief systems arose repeatedly and was a dominant theme through which many views hinge. It is notable that this discussion overwhelms the perspective of working with the minority of people who have shifted their view of climate change. This is most pertinently indicated by the contradiction in communication plans. On the one hand there is the need to connect up the isolated instances of people who are making changes and willingly adapting their farming operations to changes in climate. As indicated by stakeholder interviews this reflects the desire to move into new networks of association in which ideas and innovation can be realised with potential knowledge users. On the other there is the funding of a communication program to address the shortfall in conviction on climate change amongst those in the rural communities. Thus while there is recognition of the need to work with the willing, the funding seems to be directed at convincing the unwilling and there is no apparent emphasis on collaboration, at least as was witnessed toward the end of the data collection period.

Creating a space for emergence against the traditions of funding relationships including the industry co-investment model was represented as providing a strong case for public investment in research. The desire was expressed in connecting up the ‘outliers’ that were innovating and not part of ‘traditional networks’. It could also be said that private investment alternatives might be found, e.g., where some benefit of new water efficiency practices or markets in emissions trading arises. Alternatively, as noted by one manager, the possibility for synergies between industries might be better developed in DPI activities by emphasising regional development in which multiple industries and communities interact. However maintaining connection to past relationships while also opening new opportunities for change requires a dynamic form of knowledge development and communication. DPI will need to recognise how it mediates such activities and whether it provides conditions to facilitate or inhibit the development of sustainable livelihoods against constraints of climate change.

Opening spaces for collaboration poses the question of how new stakeholding relationships might be initiated with rural and farming communities and how that might be justified more broadly to research investors. There was recognition of the capacities in research design and development that could connect up new types of stakeholding and through interaction develop innovations for CCA. However it is unlikely that investment from traditional industry networks, as indicated by managers, is going to develop ideas that are considered ‘wacky’ by mainstream approaches to agricultural innovation. This also goes for policy stakeholders and those in other areas of government that are realising different areas of knowledge need in which DPI expertise and capability can play a role. It would seem from these arguments that a stronger role can be played in facilitating CCA and investment discussions that can break with traditions of understanding and open up to new critique about possibility and seed research inquiry to take some innovation risks.

10.8.3 ‘Strengthening’ the communication relationship

2) It appears that communication and extension of research is reinforced by a rationale in business management of getting ‘more with less’ by viewing ‘knowledge brokers’ as an important link to a wider network of rural community members including farmers. This is illustrated by a lengthening of the relationship between DPI stakeholders and extension practice by introducing new players (chemical resellers, technical advisors, etc) in the lines of communication as knowledge brokers in rural communities. This development was reinforced by comment on the analysis in another state on Greenhouse in Agriculture
that traditional research extension was not getting research outputs to its desired ‘targets’. This concern was also supported in conversation about an interest in knowledge ‘utilisation’ that recognised local networks as a vehicle for knowledge transfer. It is possible that these framings have provided some of the underpinnings for a new direction in DPI to deliver Better Services to Farmers (BSTF) which is an important way of linking up DPI CCA research to a wider social network of service provision operating in rural communities. However there is a problem with the metaphor of delivery for its inability to connect the learning dimensions of cognition as biological phenomena which results from interaction. It is establishing a set of frames that construct a cognitive and social distance between those intended ‘targets’ of research. Reconnecting the possibility for interaction and understanding to emerge out of the relations between researchers and the intended beneficiaries of research would arguably provide a more realistic construction of how knowledge is picked up and understood. We propose the metaphor which uses interactions rather than provisions as the basis for understanding research practice, extension and communication.

On the other hand there was resistance to this ‘lengthening’ of the relationship between DPI researchers and their communication networks illustrated by the perspective of research and practice change collaborations, e.g., in Ever Graze and Lifetime Wool projects in which there is a closer interaction between researchers and farmers. This perspective was supported by a view of research management in which the development of biophysical models (of plant-environment interactions) by researchers were ‘checked’ against farmers perceptions as part of the methods of validation that brought end-user’s perspectives into the picture of understanding CCA. From this perspective and others where there was closer engagement and exchange of knowledge between researchers, extension practitioners, agribusinesses and farmers the model of BSTF posed a risk to these types of activities. It concerned those who had engaged in these activities as part of CCA and other areas of integrated research that the new strategy would reduce these opportunities for research, regional development and farming practice innovations.

There was no explicit awareness of the history of the situation in which government extension services had been rationalised. The reduction in government agricultural extension service, along with a greater pluralisation of technical advice to farmers enabled by the Internet and the privatisation of farm consultancy, all contribute to the current situation. The different means of understanding how the BSTF was developing opened two different types of awareness with participants. The first exemplified a failed connection to farmers in traditional extension networks and the second demonstrated the shared value of closer interaction between research, extension and farming practice. This awareness could better direct the integration of different parts of DPI research interaction with communities of interest both in the design and development of CCA research as well as its communication and extension. On the one hand there is a lengthening of communication relations and at the same time as there is localising of CCA research relationships which produces different kinds of knowledge exchange and communication interface. Both these practices and the understanding they generate are likely to be significant to the way DPI is perceived.

There are constraints in enabling the exchange of knowledge and development of timely and appropriate support for decision making. Capacity is required in communication skills and competencies in recognising and accommodating difference as a means for interpreting uncertainty and opening a space for innovation in new ways of thinking and constructing CCA issues for the design of purposeful action. The question for DPI is how they might accommodate these differences in direction and execution of CCA research management practice and communication.
10.8.4 Rationalising immediate and longer term benefits

3) However from a wider temporal perspective there is concern that actions taken in the present may be maladaptive over the longer term. The importance attached to immediate benefits to better serve the needs of farmers and other CCA research stakeholders may lead to actions that restrict future choices. Against this view is the idea that different timing of farming decisions will occur that can lead to improved performance in the mid term, like netting and timing of irrigation, and that adaptation is merely an adjustment to adversity. That is, they may encourage ‘tinkering at the margins’ rather than support a wider systemic transformation in agricultural practice and rural and regional development. This is where the ‘no regrets’ options comes into play, e.g., where greenhouse emissions reductions are reconciled productivity increases to offset the costs of short term action with long term benefit. Thus those discussing the short term benefits were directed not only at production and resource use efficiencies but also at risk management, e.g., the benefits of using netting stops fruit damage from a number of climate threats.

This issue of maladaptive action is also given some attention in linking the short and long term benefit in relation to the cycling and accounting for carbon. Increased cropping in the south will mean increased carbon because of the loss of carbon-storing perennials. From a systems perspective this raises questions of what boundaries you place around a carbon cycling system to produce an ‘account’ - farm, regional, state, nation – and how, together, they contribute to a low carbon economy. The carbon sequestration and cycling story is one which is a feature of the linking short and longer term benefits of immediate and future agriculture and forestry development. It requires careful consideration that actions taken in the present do not close off possibilities in the future.

Furthermore there is a mismatch between modelling climate impacts and expectations. It is weekly acknowledged that climate scenarios are projections and not predictions meaning that actions taken in the stream of projections can and will alter them. This requires a different challenge in model validation than has been the case in the past. Models used as representations of reality work as predictive devices that integrate well with experimental research to validate their accuracy in representation. However when circumstances are in a state of flux and it is uncertainty whether the stability of reality will continue the same way into the future presents a set of difficulties in validating models. At best the models of climate projections and how they integrate with other farming systems models can be treated as open experiments in which models are validated against experience through real time data collection. This requires a view of models as work in progress rather than predictive devices. The IPCC never intended its scenarios of future climate as predictions but to be a de -vice to open up deliberation on what action can be taken to ameliorate the worst impacts of climate change, however they might be realised. There is a danger that DPI CCA research models are read as predictions rather than arguments of possibility designed to open up thinking and initiative on planning for an uncertainty future.

It is not commonplace that people get together and consider what type of future they would like to live in and how that might be realised through purposeful design and action. This is not something that can be achieved through existing social structures of research and policy development. It requires a new approach to CCA research that might benefit from considering how the situation has arisen and what improvements can be created to better attain desired outcomes. The view of nature as a resource for human exploitation without consequence is one of the first such consideration that might force CCA research to think differently about the interactions between human and ecological systems.

These sets of issues are offered as an illustration of how a structured analysis is a process that conditions data. It tells a particular story based on its framing of the issues. There is value in seeing how that abstractly rationalised story mediates other expressions
of CCA, e.g., in other research and practice change narratives such as development and applications of biotechnology or biological farming practices.

It is important to take a step back from the deconstructed data (separating it from the whole interview context) to see how things link up at a wider angle and for developing those connections that might strengthen a research and development framework. Here discussion has centred on three problematic areas or ‘boundary issues’ for DPI’s CCA research activity: strengthening the communication relationship; belief systems and innovation opportunities; and rationalising immediate and longer term benefits. These are now considered against the three situated perspectives of research, practice change and policy, each with different types of stakeholding with research communities and industries, local farming communities and farmers, and other government departments and policy makers. The diversity of stakeholding means need for a diversity of framing or one which can embrace the diversity with each valuing the discourse of CCA research differently. The short term risk ‘denialists’ in conservative farmers and the long terms risk ‘transformationists’ in policy makers have different knowledge needs. The question for DPI is how to engage with and reconcile CCA research activities against the range of other perspectives and issues shaping adaptation.

This expression of a CCA research management practice is offered as a possibility for considering how DPI can achieve diversity of purpose by taking a much broader view of CCA research as contributing to capacity for making decisions under conditions of uncertainty. This requires a different set of management practices and systemic design to enable an understanding of recognition of purpose and procedures for evaluating and monitoring outcome against desired goals in a dynamic social and natural environment.

10.8.5 Acknowledged limitations

The study has only looked at the perspectives of research managers and some stakeholders. As a result this had prevented a critique of research management to some degree with most of the emphasis on how researchers might better perform in the practice of CCA. However the critique has been supported through participant observations and conversations with others involved in research practice. Such an insider’s view has also been an important dimension of discerning what gets said and what gets done in the practice of research and research management. Furthermore its observations were mostly within one unit of DPI’s operations where CCA research was being practiced. Some conversations were held with others higher up in the directorate to shed further light on local understanding and one afternoon was spent in one other organisational unit in conversation with research managers and practitioners. These perspectives broadened the view captured in interview analysis which was otherwise contained to the perspectives of a few research managers and stakeholders. DPI is a large organisation embedded across multiple sites with multiple research teams, research disciplines and organisational divisions. The focus in this study was in FFSR, with an internal management perspective and external view of stakeholders both within and outside the organisation to triangulate the perspective of CCA research management practice.

Thus it captures a cultural view and is not design to be representative of the organisation but offers an view from within CCA research activities as best as that can be captured using ethnographic methodologies and systems approaches. Nevertheless by taking this account out to some of those who had been involved in the process as well as beyond through informal discussion and presentation, it is intended that this perspective be considered against others’ experience. Thus in recognition of the view being limited to management perspectives, an emphasis was given in conversation to those who worked outside of that process. They described a performance constraint in management being tied to bureaucratic and administrative processes. This was seen as limiting rather than
opening the dialogue on practice and improvement. It also pressured those who were involved in work less likely to deliver in short timeframes and tended to foster practices that closed off rather than opened inquiry processes. In other words it was governed by reductionist processes. This makes it difficult to deal with more open ended and uncertain issues such as new technologies and climate change. The issue of alternative management approaches had been considered as part of a study conducted by Boxelaar et al (2003). This studied showed that there are constraints in management practice where bounded by a positivist scientific rationality that are not well suited to dealing with the contingency of multidisciplinary, multistakeholder and open ended processes that characterise areas involving integration or complex issues.

It’s also worth noting that the inquiry, while systematic in its analysis did not necessarily collect data in a totally prescribed way. There was a basic structure that had open spaces to allow new understanding and interpretation emerge from the experiences of data collection. Thus concepts were being drawn out from the inquiry rather than a top down elicitation of data to test hypothesis based strictly on theory. It was a grounded approach to inquiry that allowed theory to emerge from the context of the situation. Therefore some aspects in the design of the research, for example, combining hard and soft systems methods were not locked down from the start. This would have made it impossible to see the system work based on experience rather than theory. Indeed I had issue from the start in being able to ‘combine’ soft and hard systems methods because I felt they had fundamentally different epistemologies that would be better served by recognising and accommodating differences. The lesson I learnt was that the benefit of systems approaches was of recognising just that – differences in epistemologies – that is if they followed an action research and social learning mode of inquiry or an open systems inquiry. At best I concluded that the accommodation of hard systems must be made within soft systems methodologies that can recognise all knowledge as socially constructed, at least in respect of how inquiry is framed and enacted.
Appendix 10.9 Agro-ecosystems Analysis

From a Presentation in Brazil by Ray Ison

Gordon Conway first used the term agro-ecosystems in the Chaing Mai study in which he was involved in 1978 (pers. comm. 2002). He then changed it to agroecosystems. Conway (1983) claimed that agroecosystems are the hybrid which results from the purposeful transformation of ecosystems for food and fibre. Conway (1987) defined it as an agro-eco-socio-economic system. The shorter Oxford English Dictionary defines agro-ecological as pertaining to the relationship between ecology and agriculture. A recent study (Wood, Sebastian and Scherr, 2000) recognises agroecosystems as one of five major ecosystem groupings. They define agroecosystems as ‘a biological and natural resource managed by humans for the primary purpose of producing food as well as other socially valuable non-food goods and environmental services’.

These definitions put the concept of agroecosystems into interesting intellectual territory. On the one hand it is often claimed that ecologists are responsible and know that there is no such thing as a free lunch. Yet agroecosystem management as a practice is concerned with getting the lunch for free or at minimum cost - hence some of the problems of contemporary agriculture. Noble laureate, Ilya Prigogine, along with others (see Bawden and Ison 1992), claim that no static system such as an ecosystem can exist and thus consequently attempts to adapt humans to a static nature are useless (Bramwell 1989).

Despite these concerns and the questioning of Prigogine and others, many in the farming systems and agroecosystems community have spent a lot of money and effort engaged in classification and assessment of either farming systems types or agroecosystem types. A model developed in the early 1980s at Hawkesbury conveyed to students the notion (innovative at that time) that agricultural systems were at the interface of natural and social systems. At that time the inclusion of the social was seen as quite radical.

A recent example of typologising on a grand scale is the study published as part of the Pilot Analysis of Global Ecosystems (PAGE) project and its follow-up Millennium Ecosystem Assessment Project. They have invested significant amounts of money and have espoused aims of the ‘development of ecosystem management scenarios that should allow one to evaluate agroecosystem capacity in specific contexts’. Over twenty years after the first writings about agroecosystems these authors argue that ‘the science and practice of environmental measurement and valuation in the context of agricultural ecosystems are in their infancy.’ All this effort is an example of what Ison and Russell (2000a) have termed first-order R&D.

The act of typologising, often aided by the latest GIS technology, in isolation from all the main stakeholders in local livelihoods, precludes learning and thus the opportunity for purposeful action. This is not to say that some planners and policy makers are not in need of some of these data but that alone and at such cost it is not nearly enough. The effect of leaving stakeholders out of the process, or out of the typologies is a bit like having a cattle drive without the cattle!

In contrast to this first-order tradition of R&D we stress the need for a second-order R&D in which the espoused role and action of the researcher is very much part of the interactions being studied (Russell & Ison 2000a).

Historically the concept of agroecosystem became the focus of attention in the South-East Asian Universities Agroecosystem Network (abbreviated to SUAN) in the early
1980s (see Rambo and Sajise 1985; Marten 1988). Other institutional participants included staff from the East-West Environment & Policy Institute with links to Human Ecology amongst other intellectual traditions. Other members included Imperial College, through Gordon Conway, and the Ford Foundation. What characterised the early network was a willingness to undertake multidisciplinary research on environmental problems.

Rambo and Sajise (1985) suggest that ‘One of the primary motivations came from agronomists at Khon Kaen University who were frustrated at the failure of farmers to adopt new multiple cropping systems that they had developed on the University experimental plots. Recognising that the problem was a social one as much as an agronomic one they sought help of social scientists to explain why farmers rejected their technological packages. The social scientists found that the new cropping systems required heavy labour inputs at precisely the time when the farmers traditionally undertook season migration to engage in wage labour. Thus the participants in SUAN began to be aware of the systemic implications of what they were doing.

What is significant about SUAN is the success of the network. Perhaps this was because they recognised the need to: (i) get acquainted - it took many meetings to develop trust and understanding; (ii) come to share a sense of commonality of problems and the research frameworks for engaging with these problems (Gordon Conway’s work in propagating the agroecosystem framework is especially acknowledged) (iii) increase interactions among scientists.

Agroecosystems analysis (AEA – Figure 10.5) is currently being used as an alternative ‘extension’ strategy in the Cambodian Australian Agriculture Extension Project (Craig et al 1997). This example was drawn to my attention by Gordon Conway when I asked him, as part of my preparation, what new developments were occurring. The project facilitates the production of commune AEAs to provide a basis for the preparation of Commune Development Plans. This project combines concepts from FSR and from AEA as depicted in the original systematic, but flexible, process model of AEA (Conway 1983, 1984, 1985, 1987; Marten 1988).

In all 509 community development plans have been produced in Cambodia since the mid-1990s and the overall project is about to receive a US$21.0 million loan to support activities in community development plans. While AEA may be undertaken at different levels, the project has the view that provincial and district AEAs are too broad to be classed as community consultations. It is argued that village people cannot be the resource or participate adequately in the RRA exercises at district or at province. At commune level they can, but it takes some preparation.

The AEA process takes a week. Fieldwork is conducted in a village location working with village participants selected in the preliminary survey. The village RRAs are conducted precisely according to Conway’s AEA for Development Manual of 1985 with the exception that the manual now uses Cambodian examples for System Properties and Flow examples etc. Two days are spent by two national, and a set of provincial staff, in undertaking the analysis procedures in the manual, producing in the end a set of Key Questions, Guidelines and Working Hypotheses. These guidelines and working hypotheses constitute the problems, issues and opportunities which are the stuff of the extension programs and of Commune Development Plans.
It is a testimony to the original AEA conception that it still appears to offer a sound foundation for work such as that in Cambodia. In conceptual and practical terms it has the feel of those described twenty years ago. What has been learned in the interim? In 1985 Rambo and Sajise suggested three conceptual and methodological challenges to be faced by AEA in the following terms:

- The need to become self-critical of the conceptual frameworks employed - how for example are agroecosystems to be defined, what are their boundaries, how do they interact with other systems?.... The key properties of rural social systems have yet to be clearly identified although equitability, autonomy and solidarity have been suggested as being of central concern.
- There is a need for increased quality control in empirical work - this has been echoed subsequently in relation to FSR, RRA and PRA.
- There is a need to make the results of agroecosystem analysis accessible to a wider audience, both policy makers and the general public.
I wonder to what extent these points remain valid? I suspect they are.

What I found attractive about AEA was that people were clearly not excluded - they were conceptualised as part of the system (although in practice it would still be possible to exclude some of the main stakeholders and to have an expert driven process). Also the connectivity in a system was explicitly recognised by appreciating the dynamics and flows. However the dynamics were and remain (as far as I know) biological or ecological dynamics and have not always broadened to include social dynamics as say occurs in collaborative action. (There are of course many forms of practice in agriculture where this shift has occurred as evidenced by our own work – see also Ramirez, 2001). AEA also encompasses a number of other key systems concepts such as:

*Measures of performance* - in addition to the five proposed by Conway (productivity, efficiency, stability, sustainability and equitability) my colleague Craig Pearson and I have suggested the need for a measure of connectivity, through communication and of response-ability of people in the system as determined by their capacity to participate (or decide not to) in any purposeful action (Pearson & Ison 1997). The measure suggested was the experiencing of an invitation.

*Hierarchy or layered structure.* My perspective on this concept follows Checkland (1999) who recognises that different observers recognise different hierarchies which is the same as saying they formulate different systems and sub-systems depending on their interest. For example if my focus is on farming (what) the level above can be regarded as a why - to improve livelihoods and that below - pastoral activity as a how. In this way the activities *what to do, how to do it and why to do it* can be linked to the concept of level and boundary recognising that for every *what* there are always many *hows* (see Figure 10.6).

![Figure 10.6 Working with the concept of hierarchy as part of systems practice (Source: Pearson & Ison 1997).](image-url)
Purpose - building on AEA and Checkland’s concept of human activity systems a model developed at Hawkesbury (Bawden et al 1985) and used for teaching and research for many years conceptualises a dynamic natural system (agroecology) being managed but managed for a purpose (Figure 10.7). This conceptualisation enabled an exploration of the question of purpose and how purpose for farming systems is attributed differently by different stakeholders. The question of purpose underpins conceptually many of the issues associated with participation. In the past researchers have often attributed purpose e.g. profit maximisation in the case of farm management economics in isolation from those affected by their attributions.

![Figure 10.7 An early version of the Hawkesbury model of farming as a human activity system.](image)

The other feature of note from the Hawkesbury conceptual model was the coupling of a farming system with a wider environment which together changed over time - an example of co-evolution not adaptation to an environment. However we soon found even this model limiting because of two conceptual deficiencies. These were to do with the concept of ‘system’ and the processes of learning.
Appendix 10.10 Inviting collaboration in an ARC Linkage proposal

Building capability of regional planning through local scientific citizenship and engagement in climate change adaptation research

Inviting collaboration in an ARC Linkage proposal for commencement in July 2011

Prof Ray Ison, Prof Alan Petersen and Ms Andrea Grant
Monash University

Aims
Thriving innovative industries in rural and regional Victoria will depend on timely and appropriate climate change impact information and adaptation knowledge. Victoria’s Future Farming Strategy is a key Department of Primary Industries policy document which outlines aims to build resilient agricultural communities that are able to deal with rapid change in dynamic social and natural environments. This document is adjoined, as part of the whole of government response to climate change, by the Department of Planning and Community Development which provides a role in leading and supporting the development of liveable communities. In further alignment with Victorian Climate Communities program in the Department of Sustainability to promote and support local community initiatives in adaptation, this research will support the integration of various sources of expert advice, research and information into a locally relevant understanding of climate projections through which sustainable livelihoods can be realised.

This research will contribute to Victorian government efforts to foster growth and development and to spread innovative technologies and practices. It offers a way of stimulating the economy by increasing the capacities of citizens to critically engage with climate science and anticipate opportunities for adaptation. The research will contribute to aspirations of reaching the full economic and social potential of regional and rural Victoria within the constraints of environmental sustainability. It will do so by enabling processes of citizen engagement through social learning and transformative techniques of recognising opportunities in a dynamic and changing social and natural environment. The research will contribute to building the capability of agricultural and rural communities to meet new challenges in an era of change by better understanding the role of co-research in sharing understanding of the opportunities and challenges of changing climates and their impacts on multifunctional agricultural systems.

There is a need for an understanding of how everyday citizens come to recognise opportunity and innovation and to realise how future livelihoods are connected to decisions made in the present. Victoria’s CCA research strategy offers a unique laboratory for examining how particular framings of research have opened such opportunities and decisions through particular social and technological perspectives of impact and adaptation. Importantly, the initial assumptions of research inquiry lead to particular trajectories of understanding and practice that potentially close off other possibilities for adaptation. There is no way of knowing in advance whether such pathways are those that will lead to more sustainable livelihoods over others. To build on opportunities and realise the most constructive pathways to multifunctional agriculture and sustainable livelihoods requires an understanding of the starting conditions and path dependencies of particular framings for gathering and assembling information in the generation of knowledge for climate adaptation. This research will ask what implications there are for moving toward a more community-based model of research by shifting from an ‘industries’ and ‘resources’ focus in research collaboration. It will consider what is gained or lost from taking community foci from traditional research relationships.
This research will explore how existing impact assessment and adaptation processes can be improved around the following propositions and through development of a systemic and adaptive framework for climate change research. Responses to change will require dealing with different groups of expertise and stakeholders demonstrating a mix of factual and value-based understanding of issues. It will require contribution from a range of discipline areas to address issues that are complex, multifactorial and uncertain. How responses to them are developed is of central importance to building collective and individual capacity to interpret and act in a climate change world. Moreover, how uncertainty is framed will be pivotal to the types of understanding of impacts and pathways of adaptation generated. This indicates there is an emergent need in developing more effective methods of communicating issues and acting with purpose under conditions of uncertainty. Importantly accommodating uncertainty in complex and dynamic issues such as climate change can be facilitated through social learning. Learning can be achieved by shared stakeholding in research co-design through recognising how inquiry is bounded and by collaborative processes for evaluating and monitoring the appropriateness and effectiveness of actions taken.

Outcomes
This research will begin to build an evidence base for understanding the implications of path dependency in research design and climate change adaptation outcomes. At this stage of the research development process we are inviting the Department of Primary Industries and a wide range of its stakeholders including Department of Planning and Community Development, Department of Sustainability and Environment, local governments and Catchment Management Authorities to contribute to and collaborate in the research. We propose the following deliverables to assist the broader integration of a whole of government approach to climate change adaptation on the basis of building community capacity for developing multifunctional agriculture including forestry and sustainable rural livelihoods.

Deliverables
1. A framework for systemic and adaptive CCA research governance
2. Enhanced community capacity for scientific leadership in CCA
3. Conceptualisation of processes for co-evolutionary adaptation
4. Enabling resilient community adaptation design and participation

The research outcomes are designed to enhance collaborative capacity and community resilience in meeting the challenges and changes emergent in climate adaptation by:

- Expanding scientific citizenship in research design and social learning processes through community participation in CCA research; and
- Accommodating difference in the understanding of impact and managing uncertainty to better realise emergent opportunities for adaptation.

These deliverables will contribute overall to the combined goals of governing bodies in sustainable living and multifunctional resource use, people driven community development, and increased cultural capacity for innovative socio-ecological advances in Victorian regions. It will engage communities in developing regional liveability and community strength, supporting resilience of community health and wellbeing, and enhancing capacity for living well within environmental limits through multifunctional resource use and efficiency.
Appendix 10.11 Building systemic and adaptive learning

Impact and adaptation in Gippsland climate study

Outline and budget

Draft work plan and budget for Ray Ison and Andrea Grant to participate and contribute to the Gippsland Climate Study

Role and rationale

Research is most successful when it contributes to learning and change. It is thus important to ‘join-up’ social and biophysical research. For example it is important to ask the right questions, to have the right people involved and to be clear from the start about the question of who will learn from this research and how. Such success does not occur by accident, so the opportunities for success have to be designed in from the start.

Researchers from the Monash Systemic and Adaptive Governance research program have experience nationally and internationally of working with stakeholders in complex, uncertain situations (such as the impacts of climate change on Gippsland communities and livelihoods) to effect on-going adaptive change. They use the term ‘social learning’ to refer these processes.

Climate change impacts will not be one-off. This ‘new reality’ makes demands on the adaptive capacity of all people and institutions in ways that are unsuited to ‘business-as-usual’ approaches. A focus on climate represents an opportunity for building on existing capability to model and understand the dynamic environment of biophysical and socio cultural change and its shaping of the future. For this reason it makes sense to understand and ‘frame’ this research within an approach that can recognise the interaction between systems and respond to surprise effects of interaction.

In addition to adding value to the overall project by preparing an ARC Linkage bid to monitor and evaluate adaptation Monash researchers will undertake the following important roles:

- Enable a open process to facilitate shared learning amongst diverse stakeholdings in the research program
- Facilitate conceptual integration of biophysical and social information and knowledge relevant to the Gippsland climate and adaptation context(s)
- Encourage the accommodation of diverse perspectives of the situation and thereby increasing the capability for critical evaluation
- Assist collaboration and stakeholding in the design and development of decision support systems enabling short, mid and long term adaptation

And contribute the following expertise:

- Social learning for adaptive and systemic governance frameworks
- Situated knowledge of real world contexts and multi-perspective analysis
- Communicating risk and uncertainty for systemic learning
- Evaluation of participatory planning and research development
Aims and contribution
The Monash researchers' aims are for building capability and understanding of the context, research design and framework for evaluation of social learning through collaborative processes. The research will involve four integrated phases including: context and background analysis; building stakeholding and collaborative vision; instilling a learning ‘system'; and generating decision support.

1) Context and background analysis
The first phase will use Systems Thinking process to describe the history of the Gippsland situation as an expression of the varied Shire contexts and as part of the background for collaboration. This part of the process will embed a historical awareness in the project and provide the basis for understanding how the study can build on and interpret understanding of the past, present and future climate impacts and adaptation responses.

2) Building stakeholding and visioning
The second phase will generate a shared vision for the study where a common purpose can be defined across multiple and diverse stakeholdings. It will contribute to the effective design of the study such that information gathered and its interpretation will be better positioned to deliver timely and relevant support to differently situated decision makers in the Gippsland region.

3) Instilling a learning ‘system'
The third phase of activity will contribute to the development of social learning in an adaptation context. Processes generated for ongoing evaluation will be optimised by a cycle of learning, reflection and action in which the consequences of action can be examined and reviewed in light of desired change and co-evolution of human activity with the built and natural environment.

4) Generating decision support
The fourth phase will contribute a framework for recognising and understanding the capacity limitations of decision support. This phase will integrate a critical assessment of the timeliness and relevance of impact data and information for effective adaptation responses. It will add to social learning processes through which decision support modelling is designed and enhance critical capacity for use of and future improvement to decision support.

Budget and timeline
*A proposed budget of $180,000 over 36 months will deliver

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<td>Project finalisation workshop (W1) with stakeholders and literature review</td>
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</tbody>
</table>
Figure 10.8 Gippsland climate study methodology including sequence and process of collaborative research activity