

# Strategic Integration: Interdisciplinary Research in Context Decision Frameworks

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## **Abstract**

Designing an integrative or interdisciplinary research program requires research leaders to make a number of decisions that relate the scientific content of the research to the larger context within which the research will be used. Drawing on a comparative study of two Cooperative Research Centres, I argue that these decisions are often strategic, based on the interplay between scientific interests and the needs of stakeholders. Because the contextual circumstances of each Centre was different, so too the actual interdisciplinary make-up of their respective research programs differed. The cases suggest that the integrative approach favoured by each Centre depended on issues such as the scale of stakeholder decision-making; the sources of scientific credibility and the risks of losing it; and the capacities of stakeholders to use different types of scientific information. Designing and assessing interdisciplinary NRM research then requires consideration of the research projects or programs in relation to their socio-political contexts.

## **INTRODUCTION**

Interdisciplinary science is often touted as being essential to the effective integration of research into policy-making or other NRM decision-making. Indeed, disciplinary fragmentation has long been regarded as one of the key barriers to the application of scientific knowledge in land management (Vedeld 1994). The implied ‘solution’ then, is that interdisciplinary research—research that effectively incorporates two or more disciplinary approaches—is inherently more ‘usable’. But not all interdisciplinary approaches or combinations can be equally useful, and there is little documented evidence to suggest that more comprehensive or complex research is *necessarily* of greater value to decision-makers than more traditional discipline-based science. So how do research leaders best make decisions about the extent and style of interdisciplinary research that is most appropriate under different circumstances?



In this paper I draw on a comparative study of two Cooperative Research Centres (CRCs) to show that the users' contexts play an important role in determining what kind of interdisciplinarity (if any) is likely to be most effectively integrated into NRM policy- or decision-making (for details of the study see van Kerkhoff, 2003; van Kerkhoff, 2002). I explore the connections between two types of integration: *scientific integration* in the form of interdisciplinarity largely coordinated and managed within the research community; and the *integration of science into non-scientific decision-making*, predominantly carried out by a range of people involved in NRM, from 'grassroots' communities through to high-level bureaucrats. Designing interdisciplinary research to achieve this second 'tier' of integration poses particular challenges to research leaders that go beyond working out how to piece a scientific jigsaw puzzle together.

## COOPERATIVE RESEARCH CENTRES — THE ORGANISATIONS

CRCs are natural science and engineering research organisations formed by formal agreements between extant organisations ('core partners') and the Australian Federal Government. They are designed to bring together researchers (from different universities, government agencies and the private sector) and research "users" (such as government, industry and community) who are involved in similar problem areas, but dispersed across different organisations and locations. CRCs are funded through competitive bids for government funding, with at least matching cash and in-kind contributions from the partner organisations, over seven years. The CRC Program began in 1990, and there are about 60 CRCs in operation at any given time (see, for example, CRC Program 2002). Both of the Centres who participated in this study began operations in mid-1999.

This study looked closely at two CRCs: the CRC for Coastal Zone, Estuary and Waterway Management (the Coastal CRC), and the CRC for Greenhouse Accounting. Both were unincorporated joint ventures between 10 core partners with various other supporting partner organisations. They were similar in budget, with the total budget estimates for the Coastal CRC and the CRC for Greenhouse Accounting approximately AU\$68 million and AU\$69 million respectively over their seven-year lifespan (CRC for Coastal Zone, Estuary and Waterway Management, 2001; CRC for Greenhouse Accounting 2001). In 2001 the Coastal CRC had about 50 full-time equivalent research staff and the CRC for Greenhouse Accounting had 57 (CRC Program 2002), although in practice this extended to well over a hundred researchers for each Centre, as almost all researchers had only proportions of their time committed to CRC projects.

The study began in mid-2000, and continued until early 2002. The findings I present here are drawn from in-depth interviews, observation, and document analysis. It is important to note that I did not conduct a full assessment or audit of interdisciplinarity within these organisations, as interdisciplinarity was not the primary concern of the study. Instead I report here on what might be regarded as the interdisciplinary *ethos* or *aspirations* of the Centres, and the ways they constructed their research programs to facilitate the achievement of those aspirations.

## THE INTEGRATION MANDATE IN CRCs

Both Centres needed to conform to the general requirements of the overarching CRC Program. There are three formal mechanisms by which the CRC Program encourages integration among the partners within a CRC: prior to formation, through application processes; at formation, through legal contracts; and following formation, through review processes.

To be successful, CRC applications must meet the Application Guidelines. These highlight the importance of integration, stating that:

*... the CRC should result in substantial integration of research activity that goes beyond the existing research efforts of the individual participants. (CRC Program 1999:6).*

and further:

*Participants should form collaborative relationships within an integrated research program. Participants should not divide the research program into discrete projects that are carried out solely by individual participants, pursuing their own separate objectives. (CRC Program, 1999:8).*

Following the success of a bid, integration is reiterated through the review process. The Centres are funded for seven years, and undergo a formal review in their second year. In this review the CRCs are assessed on:

*The degree to which key user groups, including industry, have been integrated into the CRC as core participants, and have made substantial commitments of resources*

[and]

*The degree to which the CRC has built links between the participating research groups and organisations, and integrated and enhanced their activities in research and education. (CRC Program 2001:14).*

As such, the second year review is an assessment of how the requirements of the Application Guidelines and the contractual obligations are being implemented. It acts as a check against any temptation to give 'lip service' to the idea of integration.

These formal requirements of the CRC Program specify scientific integration 'within' the research both through the configurations of participants in the research projects (projects should involve researchers from different core partner organisations) and in the sense that the project activities themselves needed to form a coordinated suite of activities rather than an ad hoc collection. As such, integration within research needed to address both interdisciplinarity *and* inter-organisational cooperation. The CRC Program also specified integration as being between the research communities and 'end users'. As such the Centres illustrate the loose nexus that is often drawn between interdisciplinarity and the usability of research.

## The integration mandate and drivers in the Coastal CRC

The Coastal CRC emphasised the integration between science and coastal management. It was promoted from the outset as a ‘bridging’ organisation, linking scientific research to stakeholders to bring about better coastal management in Australia. In their original bid proposal, the Centre’s proponents described their mandate as:

*To bridge the gaps between science and the community, and between science and decision-making, policy and planning in the coastal zone. (Anon, 1998:1)*

This later formed the basis of the CRC’s mission statement. As such, within-science interdisciplinarity or inter-organisational partnerships were not viewed as ends in themselves, but rather as tools to facilitate this very broad bridging function.

This emphasis on bridging the gaps between science and non-scientific sectors can be at least partially attributed to the state of coastal management in Australia. Coastal management is a highly fragmented issue politically and managerially. The number of government agencies with responsibility for coastal management is high and includes local government councils, who are responsible for water supply and sewerage as well as coastal development; State government agencies, including environment protection authorities and natural resource management agencies with a wide range of legislative responsibilities in the coastal zone; and Federal Government departments, including Environment Australia, and Agriculture, Fisheries and Forestry Australia, as well as Federal statutory authorities such as the Great Barrier Reef Marine Park Authority.

For the Coastal CRC this complex situation was coupled with increasing pressure on industry to reduce their impact on coastal environments (from any or all of these government sources, as well as public pressure), and increased community awareness and activity in water quality management (Waterwatch, Sea-grass Watch, etc.). In other words, the number of stakeholders was high and their backgrounds and interests were diverse. In particular, their demands of science—what they believed research could usefully contribute to their decisions and activities—were highly varied. So for the CRC to effectively engage with relevant stakeholders required that the researchers be somewhat flexible depending on what they were researching and who they were working with. There was no ‘one size fits all’ interdisciplinary or integrative strategy that all stakeholders would see as valuable and useful.

## The integration mandate and drivers in the CRC for Greenhouse Accounting

The main objectives of the CRC for Greenhouse Accounting were to:

*...attempt to understand the Australian terrestrial carbon cycle and how it responds to global climate change. To do this, the Centre will research and develop innovative, cost-effective methods for land management and accurately measuring and forecasting change in land-based carbon stocks.*

*The Centre will also help devise and promote modern tools for managing land-based carbon so as to help achieve national greenhouse gas reduction objectives. (CRC for Greenhouse Accounting, 2001:inside cover).*

The CRC for Greenhouse Accounting was therefore quite ‘science specific’ as it was concerned with a particular aspect of climate change—the flows of carbon through land-based ecosystems. It was also, in comparison with the Coastal CRC, specific about the science/non-science integration it sought to achieve, including the development of methods for particular managerial activities (measuring and forecasting change in land-based carbon) and specific about working at the national scale.

The CRC for Greenhouse Accounting differed substantially from the Coastal CRC in its drivers for integration. At the time of its formation, several major political forces were developing in both the national and international political arenas. At the international level, the Kyoto Protocol negotiations were in full swing and at the time of funding (mid-1999), several CRC researchers were heavily involved in contributing to the Intergovernmental Panel on Climate Change scientific reports on land-use change as a source or sink of greenhouse emissions. This was a highly political issue in Australia, as the Federal Government’s position at the Kyoto negotiations argued strongly that sinks should be included in calculations of how far a country would be required to reduce its carbon emissions. This was in large part based upon the belief that Australia, with a large capacity for plantation afforestation, would benefit from the inclusion of carbon sinks if large-scale forest regrowth counted as carbon credits. This would reduce the impact of emission targets on other economic sectors and place Australia in a strong position in terms of international carbon trading, but was also a position that was being strongly criticised by the international community.

As such there was considerable uncertainty at the time the CRC began about both international and Australian greenhouse policy. To maintain relevance to a user community within this very changeable atmosphere, the Centre effectively ‘tied’ its activities to specific government initiatives, including an inventory of Australia’s carbon stocks, and the development of a national-level system for accounting for changes to those carbon stocks. Several CRC researchers had been involved in these government activities prior to the formation of the Centre. The CRC for Greenhouse Accounting emerged largely in response to what was seen as an ongoing need for research to further develop and refine these tools, regardless of the eventual outcomes of international and national negotiations. This high-level, concentrated focus of stakeholder interest was a stark contrast to the local, dispersed groups with an interest in coastal management.

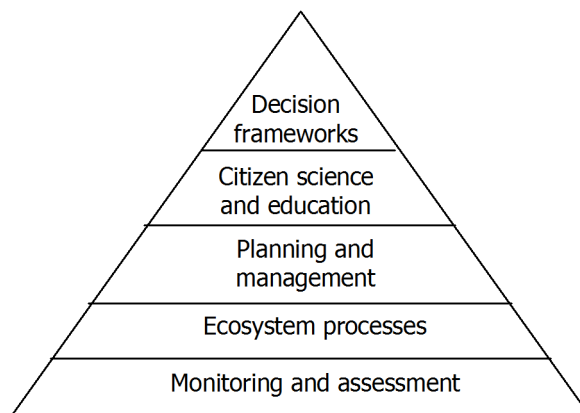
Like the Coastal CRC, the CRC for Greenhouse Accounting was a mechanism for coordinating and bringing together a wide range of skills, expertise and data that were relevant to carbon accounting, but dispersed over several disciplines and several universities and research agencies. However, unlike the Coastal CRC, the major government actions in the area of carbon accounting (the inventory and development of the new accounting system) were centralised, being coordinated by a single national agency, the Australian Greenhouse Office (AGO). This was a new agency at the time the CRC started, and had been initiated by the Federal Government as part of Australia’s response to the international negotiations surrounding the Kyoto Protocol to act as a central point for all greenhouse-related issues. The AGO spanned several existing government departments and agencies who each were responsible for different aspects of climate change, including Environment Australia; Agriculture, Fisheries and Forestry Australia; Transport and Regional Services; and the Department of Foreign Affairs and Trade. Consequently, much of the coordination that the Coastal CRC needed to do to

identify key stakeholders and bring them together had already been done through the formation of the AGO, and early work commissioned by the AGO on the National Greenhouse Gas Inventory and the National Carbon Accounting System.

So, the CRC for Greenhouse Accounting's research was relevant at state, national and international political scales, but to relatively limited and clearly defined groups: State Government forestry agencies and natural resource management/land management departments, and the AGO in particular.

### **Organising for interdisciplinarity and integration: the Coastal CRC's research structure**

The Coastal CRC's research was carried out in projects (many of which were broken down into tasks), which were placed in clusters that formed five research themes. The themes formed the main organisational structure of the CRC's research. They were not discipline-based, but rather organised according to what might best be described as their scale of management relevance. The five themes were: Monitoring and Assessment (managing individual species); Ecosystem Processes (managing interrelations between species); Planning and Management (managing biophysical ecosystems); Citizen Science and Education (managing people in ecosystems); and Decision Frameworks (managing people and ecosystems together). The five themes were habitually presented by the CRC as illustrated in Figure 1.



**Figure 1.** The Coastal CRC's thematic structure. (Source: CRC for Coastal Zone, Estuary and Waterway Management, 2000).

In this representation of the research structure, the theme at the base of the triangle feeds into the next level up, and so on, in increasing levels of complexity until the final theme, decision frameworks, incorporates information from all of them. Each theme was interdisciplinary: monitoring and assessment, for example, drew on a range of biological, ecological and chemical sub-disciplines, as well as hydrologists and engineers, depending on the actual task at hand. The large number of researchers with a role in the CRC meant that research teams could be flexible and eclectic, 'borrowing' people for short-term contributions as well as more formal involvement in projects.

The thematic structure as a whole was also highly interdisciplinary, with ecological economists and computer modellers in the Decision Frameworks theme; sociologists and historians in the Citizen Science theme, etc. In scientific terms then, the CRC covered a very broad sweep of research that could offer insight into coastal management. However this structure in itself did not offer any solutions to the difficulties of managing the localised interests and range of stakeholders to ensure the research was relevant.

To try to achieve this relevance, the issue-based thematic structure was complemented by a second structure: Management Study Areas (MSAs). These were physical locations where CRC research effort was concentrated. The four MSAs were South East Queensland (rivers and estuaries of Brisbane and Moreton Bay), Fitzroy (Central Queensland, based in Rockhampton), Gladstone (an industrial port on the Calliope River, also Central Queensland), and National (nationwide research). This second structure allowed the Centre to focus its research geographically, and was intended to facilitate interdisciplinary cross-fertilization across the themes of the pyramid in Figure 1. For example, the sociological research of the Fitzroy region could inform the planning and management projects in the same region. The MSAs also served to limit the stakeholders involved to those with an active interest in the locations.

The overlay of physical locations over themed groupings was described by one participant as a matrix arrangement, where research activities took place simultaneously in two dimensions, as represented in Figure 2.

Theme/MSA	SE Queensland	Fitzroy	Gladstone	National
Decision frameworks				
Citizen science				
Planning and management		Project x		
Ecosystem processes				
Monitoring and assessment				

**Figure 2.** A matrix of Themes and Management Study Areas.

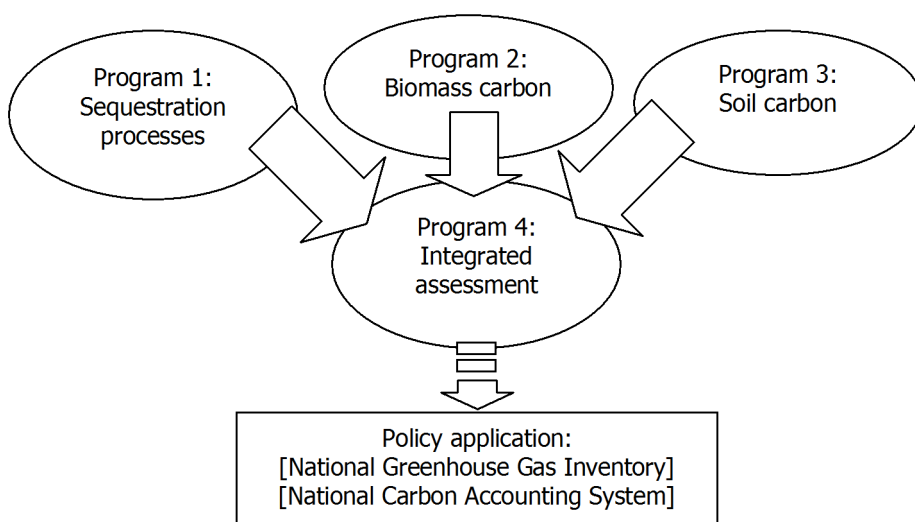
Focusing their research in these areas was intended to achieve two things: first, increased cross-fertilization of ideas and research results within the scientific program; and second, increased local relevance of the Centre's research to relatively clearly defined groups of stakeholders. The trade-off was essentially between the geographic relevance of the CRC's research (now quite limited) and the ability to integrate research both in interdisciplinary terms and in terms of its relevance and usefulness to stakeholders.



## Organising for interdisciplinarity and integration: the CRC for Greenhouse Accounting's research structure

The original research structure of the CRC for Greenhouse Accounting was based on four programs, with a fifth supporting program, Education and Outreach, managing postgraduate students, other educational activities, and public communications. (The research structure changed towards the end of the study following a strategic review, the original structure is the one drawn on here.) The four research programs were Sequestration Processes; Biomass Carbon; Soil Carbon; and Integrated Assessment. The range of disciplines involved was considerable, from fundamental research into plant physiology through to soil chemistry, ecology to computer modelling.

The first three programs were designed to feed information into the fourth program, Integrated Assessment. This is illustrated in Figure 3.



**Figure 3.** Research flows in the CRC for Greenhouse Accounting.

Figure 3 illustrates the structures in place to bring the scientific research together, in the single program (Program 4), rather than the ‘progressive’ integration envisioned in the Coastal CRC’s triangle model. Two of the four projects in Program 4 were designed specifically to “assist the future development of the National Greenhouse Gas Inventory ...” (CRC for Greenhouse Accounting, 2000, pp. 24–25), while the other two sought to provide ‘timely assessments’ to policy-makers. This was in contrast to the other programs, that were largely concerned with more conventional ‘scientific’ goals such as ‘improving understanding’ or developing better, more cost-effective carbon measurement techniques. Indeed, there were clearly pockets of activity within the CRC that were not interdisciplinary and were not intended to be. Program 1, for example, Sequestration processes, was made up of four projects. The first two were predominantly biological projects concerned with the physiology of carbon sequestration in plants. These were conducted by researchers from a single research school of biology.



The main integrative activities of the Centre were the formal modelling and policy advice projects in Program 4. The Integrative Modelling team were attempting to build a computer-based 'shell' that other research programs could feed their own results or more context-specific models into. The policy advice projects sought to synthesise CRC research into informative briefings for policy-makers.

## INTERDISCIPLINARY STRATEGIES: PUZZLE OR PARTICIPATION?

These Centres offered two different interdisciplinary research strategies. The Coastal CRC emphasised a very broad range of disciplines, and the participation and direct involvement of the wide range of stakeholders in the research. This was to help ensure that the science was relevant to those stakeholders and the specific decisions they were facing. The actual disciplinary make-up of the projects, then, was a result of both the scientific case for improved understanding through interdisciplinary approaches, and negotiations with stakeholders about the information they needed. These issues were negotiated at the project level, by project leaders and research team members, with the stakeholders and the CRC management. Boundaries were set by the Management study areas and the project themes. The project level stakeholder involvement meant that the Coastal CRC's research program as a whole tended to be eclectic rather than comprehensive, but this eclecticism allowed the researchers to tailor their projects to local circumstances.

The CRC for Greenhouse Accounting tended to interact with its stakeholders at a higher organisational level, with negotiations typically taking place between the Executive of the Centre (the CEO and program leaders) and a small group of policy-makers. These negotiations influenced the Centre's strategic research direction as a whole, but allowed the projects to take a more conventional approach to interdisciplinary research, creating projects that would eventually 'fit' together in a scientific jigsaw puzzle. The integrative strategy of the CRC for Greenhouse Accounting was largely one of developing science-driven expert advice, that is, independent scientific information that was designed on the basis of research leaders' understandings of users' needs.

Given that these Centres shared the same administrative and organisational structures and backgrounds, the differences between their interdisciplinary and integrative strategies can be attributed at least in part to the interplay between the researchers, in particular the research leaders, and the context of application of their science. In other words, the decisions about what *types* of interdisciplinary research the centres could or should engage in need to be considered in light of the integration between the research and various government or non-government stakeholders responsible for applying their research.

I will briefly outline three key differences in the socio-political contexts of the two Centres that may help to explain the different interdisciplinary approaches.

## Scale

It was noted earlier that coastal management was predominantly a local issue. This level of management requires more fine-grained research input than is commonly generated by the research community, with the scientific tendency to work at larger, more abstract scales. This was a failure that the CRC recognised and sought to overcome by involving local managers and stakeholders in the research itself, to help define what would be useful to them and bring about a productive mixture of practical and scientific interests.

In contrast, greenhouse accounting issues were predominantly of interest to those involved in the very uncertain and changeable international, national and to a lesser extent State policy environments. That these issues would eventually become more relevant to smaller scale players such as local governments and industry groups was highly likely, but as their actions would depend on the resolution and settling of the higher level situation anyway, they had little current interest in greenhouse accounting. The main problem confronted by the national policy bodies was the fragmentation of scientific information that was relevant to the new application of carbon accounting. Being larger in scale, the more conventional, abstract research approach was not a problem—highly localised studies would not make much contribution to devices such as the National Carbon Accounting System. Consequently the integrative strategy of the CRC for Greenhouse Accounting aimed to bring conventional research together.

## Credibility and risk

Another key difference between the two Centres was the risks they confronted in creating a credible, relevant research program. The CRC for Greenhouse Accounting's research was placed within a highly controversial political debate about Australia's role in greenhouse abatement, increased by the Federal government's contentious position with respect to the Kyoto Protocol. One consequence of this was that the stakeholders themselves tended to demand fairly conventional science. More radical research approaches—including participatory research—were not encouraged by the stakeholders, as perceptions of deliberate or inadvertent political influences on the research could reduce the credibility of the Centre. The CRC's specific, explicit and conceptually quite targeted scientific mandate can be understood as a way of managing this risk.

This was in contrast to the Coastal CRC, who limited their stakeholder groups by targetting their research in Management Study Areas but did not restrict the conceptual range of their research activities to particular aspects of coastal management. They confronted a very different risk, that conventional science approaches would not take the needs of the 'real' managers into account, and therefore they would fail to contribute to management. Encouraging direct participation of stakeholders was a way of reducing this risk.

## Capacity to use research

The third difference between the two Centres was the capacity of their stakeholders to act on scientific information. In many respects, the CRC for Greenhouse Accounting's major stakeholder, the Australian Greenhouse Office, was a quasi-scientific organisation

in itself. The branch of the AGO responsible for working with the CRC was staffed by several scientists as well as policy-makers. Consequently, the major stakeholder had the capacity to use highly technical and complex scientific information very effectively. The capacity of stakeholders in the Coastal CRC to use scientific research varied enormously, and it was often difficult to assess from ‘outside’ just what those capacities were. Involving the stakeholders in the research helped researchers to determine the degree of scientific capability present in their stakeholder communities, both to contribute to the research and to absorb and act upon its outputs.

## CONCLUSION

While it is common for researchers and others to think about interdisciplinarity in terms of overcoming a *scientific* challenge of fragmented understanding and isolated information, this study indicates that in the context of NRM it can also be a strategic response to the stakeholder environment. Different stakeholder environments demand different interdisciplinary approaches if the research is going to be usefully integrated into decision-making. This study has suggested that factors such as scale, risk and credibility, and capacity to use research are factors that may shape different integrative approaches, but these are indicative rather than comprehensive.

However, research organisations are not solely at the mercy of these extraneous forces. The decisions that research leaders make about how they wish to place their research within the socio-political stakeholder domains—where they want their research to make a difference—also makes a major contribution. In other words, research leaders can choose to target different stakeholder groups depending on their own scientific aims, interests and capacities. It is at the intersection of these domains that the strategic nature of interdisciplinary research design comes to the fore.

This has implications for both designing appropriate interdisciplinary research programs and assessing existing programs. Understanding how and why interdisciplinary research may or may not be successful in bringing about improved NRM therefore needs to look closely at the ‘goodness of fit’ between the scientific and socio-political contexts.

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