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Reward, risk and response in Australian Cooperative Research Centres

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Abstract: Cooperative research centres are a well-established organizational embodiment of the ‘triple helix’. As complex inter-organizational structures they are subject to diverse management strategies. The imperatives that drive their strategic plans and their impact on partner organizations and the careers of the scientists who work within them are not well understood. We examine 370 participants’ experience in Australian Cooperative Research Centres and consider their effect on personnel and organizations in the public research system. We propose that a necessary part of management strategies is the negotiation and reconciliation of risk and reward for partner organizations and careers of participating scientists. Achieving a sustainable strategy carries implications for change within the partner organizations and for the endurance of CRCs as organizational arrangements. These emergent triple helix structures can be harbingers of change not just for the alternative institutional structures they present and the partner organizations, but also for the careers of scientists.

Keywords: Australia, Cooperative Research Centres, cross-sector R&D, research organization, research policy, university-industry linkages, government research

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1. Introduction

The Cooperative Research Centres (CRC) program is the Australian Government's largest single investment in cross-sector R&D absorbing A\$200 million annually in federal funding. The Centres are archetypal 'triple helix' structures: highly complex inter-organizational arrangements involving universities, federal and State (provincial) government research agencies, individual firms, and various industry-led public sector intermediaries.

CRCs were first funded in 1990, following the example of centres like the US NSF Engineering Research Centers and the UK Science and Engineering Research Council's Interdisciplinary Research Centres in the mid 1980s. Over the life of program, 168 centres have been established: 102 of these were new, and 66 were formed from existing CRCs (O'Kane, 2008). There are currently (2007-08) 58 CRCs in operation, covering a wide range of industrially-oriented research (such as polymers or advanced automotive technology) and 'public good' research (such as Aboriginal health or greenhouse gas accounting), each funded for an initial seven-year term (renewable, subject to competition, where a significantly new research is proposed).

The CRCs' US antecedents, Industry-University Cooperative Research Centers (IUCRC) have been in place since the late 1970s (Cohen *et al.* 1994). These collaborative structures have been complemented by the Engineering Research Centres (ERCs) and the Science and Technology Centres (STCs). All are directed in one way or another towards enhancing technology transfer (Steenhuis and Gray, 2006). Like the Australian model these centres, apart from their potential contributions to technology transfer, carry implications for organizational management. Steenhuis and Gray have drawn attention to the various organizational strategies adopted by these US centres.

The importance, organizational complexity, financial scale and potentially far reaching implications of these research organizations necessitate an emphasis on the management systems and structures of STCs (Steenhuis and Gray, 2006, p. 58).

Steenhuis and Gray's findings (2006, pp.74-76) suggest a wide variation in management strategies between centres. This could be because optimal organizational management models are still evolving, or the nature of centres is so varied that strategic management models will always be somewhat heterogeneous. They suggest,

however, that variation in strategies emerges because cooperative research centres are not in competition with other such centres but are acting as intermediaries between academic research interests and the technology interests of the commercial partners.

Although they may in practical terms be operating as intermediaries, the partner organizations – universities, public research institutes and firms – that make up these triple helix entities are in highly competitive environments. Universities compete with each other for students, staff, research income and academic kudos. Research institutes also compete for scientific staff, for external research funding, for treasury budget allocations and government contracts. Industry partners are in a commercially competitive environment, but also compete for scientific staff and the intellectual property rewards this can bring. Moreover, as we have documented elsewhere, collaborative research centres are also in competition with the departmental organizational structures that exist within their partner universities (Garrett-Jones et al 2005a). This has implications for the career options for research personnel. There are potential rewards such as access to new equipment and to be working with leading-edge scientists. There are also potential risks for scientists that their work and consequently careers may be driven in unintended directions by their CRC involvement. As CRC researchers seek to resolve tension between potential rewards and risks there are also implications for the partner organizations. This is because linking their career options more directly to a CRC is often achieved by reducing commitment to the partner organization that employs them.

1.2 Managing CRCs

A wide range of apparently successful management structures have evolved across the Australian CRCs. They sometimes engage a chief executive and administrative and R&D staff in a central office, but most CRC researchers are employed by their university, business or government laboratory where they continue to work, rather than by the CRC itself. To this extent the CRCs are virtual centres – even if legally incorporated. CRCs, like other industry-linked research centres, can thus become highly complex inter-organizational networks. For example, the CRC for Polymers – now in its third round of 7-year funding – combines 11 participant companies in the plastics industry (two of which are spin-off companies from the CRC), two large federal government research agencies, 10 universities, a state government department

and another independent cross-sector R&D centre. What is perhaps different about Australia's CRCs compared with cross-sector R&D centres in other countries is the strong involvement of the government research sector, particularly the CSIRO, Australia's largest federal research organization. Government (federal and state) is therefore represented not just by facilitation and finance, but by day to day participation as a partner in the research program of most CRCs.

The CRC collaborative model and the variety of management approaches for organising them have attracted considerable attention and debate. The common themes in the literature focus on the tensions between differing industry and public sector expectations and objectives. However, while these are clearly important factors, the drive to maximise opportunities for 'reward' and minimise 'risk' from the multifocal point of view of research personnel. has received less attention. In these evolving triple helix structures there are risks for organizational partners and there are risks for scientists' careers and for their students. We aim to understand more about the experiences of CRC research personnel (researchers and research managers) and the extent to which their expectations and work at CRCs are contributing to the formation of sustainable organizational structures. Our objective is to shed light on two key questions: (1) what drives a researcher to become involved in (and to stay committed to) these complex and often unwieldy organizations; and (2) how do researchers perceive and manage the *risks and rewards of participation* in these centres. Answers to both questions carry implications for the effective management of CRCs and their organizational sustainability, as well as for their constituent partner organizations.

2. Critical Issues in the Literature

There is a large body of literature on cross-sector R&D collaboration that seeks to explain how CRC-type organizations have evolved and how they can best be managed. Three enduring research themes within this literature are of direct relevance to our interests in this article. These are: (1) explaining how the competing goals and expectations of partners can be integrated within a single collaborative centre; (2) explaining how trust is (or is not) generated and the implications this has for how partners interact with and treat each other; and (3) explaining how the careers of scientists might change through the choices they have within CRCs.

2.1 *Synthesising Competing and Complementary Goals*

According to Lee (2000) a sustainable collaboration is one where each partner allows the other to realize their objectives while also contributing to mutual goals. The problems that arise in the management of CRCs can thus be understood in terms of the difficulty of accommodating heterogeneity in the cultures and ‘functional domains’ of the partners and of avoiding potential competition between them (Garrett-Jones et al., 2006). For example, the reward structures of the partner organization and the CRC may not be aligned, or scientists may find the commercial imperatives of industry too short-term. This leads to a perceived problem of coordination and governance in a multi-institutional environment where the partners and research personnel essentially remain free-agents.

Yet inter-organizational networks like CRCs seek to encourage innovation by bringing together people *with* a diversity of expectations and goals, and with greater ‘cognitive distance’ (CD) between them (Nooteboom, 2000). A large CD has the merit of bringing in new ideas, but also creates problems of incomprehensibility. The partners will have different views – not just about the science of the project, but, as Gibbons et al. (1994) point out, also about what constitutes ‘fair play’. Siegel et al. (2001, p. 5) succinctly identify the management issue in these sorts of cross-sector R&D arrangements:

A critical organizational issue is how universities and firms manage these relationships, in light of the fact that the key players in [university-industry technology transfer] (i.e., scientists, university administrators, and firms entrepreneurs) have different motives and incentives and operate in different organizational cultures.

It is necessary then to consider first what is regarded as legitimate competition, collaboration, ownership and reward (Gibbons et al., 1994), and second how objectives and strategies are defined and implemented (Steenhuis and Gray, 2006). This raises the question of what appropriate balance between trust and ‘formal government’ (Menard, 2004) is required to coordinate cross-sector R&D organizations, and what form of ‘governance’ and rules are accepted and enforced. Much of the debate around this issue concerns the differing expectations of CRC partner organizations and how this can best be managed. We are concerned here

equally with the expectations of the research personnel who constitute the CRC but who have concurrent employment commitments to partner organizations.

2.2 *Building Trust between Partners*

Although CRCs are formal structures, they remain to some extent ‘virtual centres’. Researchers, funding and projects come and go – bringing with them organizational allegiances, expectations and commitments - and taking them with them if they leave. Holland and Lockett (1998, p. 606) describe the coalescence of virtual organizations around outcomes, and the need to deal with the risk that the outcome may not be achieved: ‘there is a significant level of risk associated with the outcome... and *organizational trust* has been hypothesized to be an explanatory variable for the development of such cooperative behaviour’. For Daellenbach and Davenport (2004, p. 189) ‘this reflects the expectation that partners will act competently and recognize and protect the interests of other alliance members’.

In a voluntary alliance like a CRC the participant organizations and individuals expect to be involved in decision-making and to be ‘justly’ treated if they are to remain a member. Daellenbach and Davenport (2004) assess the role of distributive justice (fair allocation of outcomes and rewards) and procedural justice (fair handling of processes, such as decision making, agreement on procedural norms, conflict resolution and governance) in the establishment of technology alliances involving firms and public sector research institutes. They note that how these elements of governance are dealt with is crucial to building trust within the collaboration.

Academic science is built on trust in the quality and validity of research performed. This is ensured through public sharing of knowledge (Liebeskind and Oliver, 1998). However, in the context of cross-sector R&D, this raises the questions of how partner organizations from each of the three sectors and the research personnel are selected in the first place (Daellenbach and Davenport, 2004).

Nooteboom (2000) deals with this issue by distinguishing between two elements of trust: *competence* (or the capability to deliver the agreed outcomes) and *intention* (the degree to which parties are committed to the avowed goals and avoid opportunism — that is, putting self-interest above the goals of the centre). But for us, trust is a very personal measure. Organizational trust emerges only to the extent that its *members* trust the members of another organization. This further directs our

analysis to the experiences and expectations of the research personnel. How do individual participants assess trust and reputation (and its breach), how is trust built and how do they respond when faced with opportunist behaviour?

2.3 *Career choices and balancing reward and risk*

Several studies have examined the value of participation in cross-sector R&D centres for business participants (Adams et al., 2001; Feller et al., 2002). Industry perspectives from our present study are reported elsewhere (Couchman and Fulop, 2004). For business partners rewards are generally tangible and well articulated, such as acquiring new intellectual property, developing a new product or solving a problem in production. For individual public sector researchers rewards may be less tangible such as extensions to research networks and access to new ideas and new research problems. But they are just as important for weighing up employment career options. As Lee (2000) points out, university researchers would not engage with industry unless they felt that the collaboration brought them significant and important benefits. But for research personnel we would expect a greater degree of intangible benefit than for business partners.

Lee's survey of 427 faculty members in US universities who were engaged in R&D projects with industry showed a range of motives for collaborating with industry. Among the benefits he identifies for university researchers are: funding for research and scholarships, insight through practical application of research, experience relevant to teaching, job placement or business opportunities, and furthering the mission of the university. The material benefits of funding for research staff or equipment were most highly regarded, as were the intangible benefits relating to gaining insight into ones own research and testing applications of theory. Expectations were generally realized as benefits in Lee's study: a majority of faculty members experienced 'substantial and considerable benefits to their academic research dimension' (p. 121). Other motivations such as seeking entrepreneurship, jobs for their students, or furthering the university's mission were not nearly as important to them. This finding, however, is somewhat puzzling as it runs counter to the growing body of literature showing that scientists make career choices because of the more intangible benefits such as enhancing science networks, kudos and testing

new ideas (Turpin *et al*, 2008). It may reflect national differences in institutional research funding mechanisms.

Recent work by Dietz and Bozeman (2005) compares the career paths and achievements of 1200 US academic scientists working in industry-linked research centres, contrasting those who have worked solely in academia with those who have followed 'non-traditional' paths involving work in industry or government. Dietz and Bozeman hypothesise that, for academic scientists, 'intersectoral changes in jobs throughout the career will provide access to new social networks, resulting in higher productivity' (p. 353). They also note that 'job diversity [is] associated with increased collaboration' (p. 353). They suggest that the research centres are having measurable impact on the research careers of engineers and scientists and, consequently, on the culture of the universities that employ them.

Steenhuis and Gray (2005, 2006) make two observations on the US centres that are pertinent here. The first is that the more recently established centres have directors who are more industry focused and 'better prepared to deal with strategy development' (2006, p. 76). Secondly, in the USA, the development of strategic plans is driven by different management approaches. In the case of IURCs they are driven largely by external groups. In the case of ERCs they are driven by creative leaders, and in the case of STCs, by management teams. In contrast, in typical university research centres the strategic plan is driven by an individual or group of faculty members. Thus Steenhuis and Gray argue that it is the nature of the program with its specific technological and commercial objectives that attract specific drivers for strategy.

All of the critical he issues discussed above deal in one way or another with ambivalence surrounding choices about working in CRCs. At an organizational level choices are made about shoring up institutional credentials, about investing financial and human resources and about pressing for certain strategic directions to gain return from these investments. At an individual level choices are made about setting research priorities, applying for grants, preparing publications and maximising options for future employment and careers. In making choices about their careers research personnel will the consider strength of their allegiances to various partner organizations within the CRCs. We are interested to know how individuals make these choices, about the implications for the partner organizations and for the sustainability of the CRC as an enduring organizational structure. At a broader level

we believe this analysis can inform the proposition presented by Dietz and Bozeman (2005) that academic careers are changing in some fundamental way.

3. The Role of Government in CRCs

Government research institutions are directly involved in most Australian CRCs as partner organizations and have invested over A\$1 billion of their research funding through such collaboration (O’Kane, 2008). They bring to the CRC expectations from government about how their institutional research budgets (public funds) should be strategically managed. The program as a whole is managed and funded by the federal Government which has invested around A\$3 billion over the life of the program. An equivalent amount has been leveraged from universities (O’Kane, 2008). Government expectations about the strategic direction of the program have been inconsistent. Program objectives from the outset were to promote ‘the links between research and its commercial and other applications’ (Slatyer, 1994). Objectives ‘drifted significantly’ from the original ones through the ensuing decade (Howard Partners, 2003) with the government insisting on a more commercial focus for the CRCs. In the initial rounds of CRCs an industry partner was ‘strongly encouraged’ but was not mandatory (Cooperative Research Centres Committee, 1991). In 2004 the government announced that the CRC Program would have ‘a stronger commercial focus’ through strong industry partners and plans for commercialisation or utilisation. Similar observations have been made about collaborative centres in the US becoming more multidisciplinary and more application-oriented (Steenhuis and Gray, 2006).

Recently, a national review of the Australian CRC program has recommended a move towards broader public good outcomes and translating investments into social and environmental benefit as well as economic benefit. The review also calls for a stronger focus on delivering end-user benefits rather than being directly involved in commercialization, and encourages greater flexibility in strategic directions (O’Kane, 2008). This ebb and flow of government expectations between commercial or public good priorities carries implications for those within CRCs. As program objectives shift so too will the expectations, career options and allegiances among the personnel involved in the centres.

CRCs in Australia differ from programs like the US Engineering Research Centres in covering a broader spectrum of research; in having more the character of

‘virtual institutes’ (researchers largely remain employed by their ‘home’ organization, not by CRC itself); and in many cases (despite an original intention of research concentration) by being widely distributed geographically across Australia. Effectively, they combine the objectives of all three US Centres programs described above. Thus the Australian centres are more heterogeneous in their objectives and contexts (and potentially – following Steenhuis and Gray – in their structure) than, say, the US IUCRCs or ERCs. We therefore expected to find a greater degree of variation in the way Australian CRC research personnel are motivated to join CRCs and subsequently balanced opportunities for reward with potential risk, than in the studies reported elsewhere.

4. Methodology

Our empirical evidence is drawn from a survey of 370 respondents from public sector organizations involved with CRCs carried out in 2005. The written, mixed-mode (postal and web-based) survey covered a non-random but representative sample of people involved in the management and conduct of CRC-based research (Diment and Garrett-Jones, 2007). Respondents (34% response rate) comprised researchers and research managers involved either directly as participants in one or more of 37 CRCs or indirectly with CRCs (e.g. responsible for managing some aspect of the organization’s involvement in the CRC). The majority of respondents (53 per cent) identified themselves as from the higher education (HE) sector, with 21 per cent from the government research (GR) sector. Analysis of in-depth interviews with around 30 research managers from university and other public sector partners of selected CRCs (Garrett-Jones et al., 2005a) was used to develop the questionnaire for the survey. It was also informed by related research on the career paths of scientists in Australia (Turpin et al., 2005).

The survey questionnaire presented 48 propositions about the respondent’s experience with the CRC program, under four headings:

1. the benefits of CRC participation to the respondent and their organization;
2. the problems encountered;
3. the management strategies adopted for participation; and
4. the effect of CRC participation on research training and career structures.

Respondents were invited to rate each proposition on a six-point Likert scale. The final question (optional) in each section allowed an open-ended response to each theme. More than half of the respondents answered at least one of these open-ended questions.

The survey results permit a quantitative ranking of the main benefits and problems in CRC participation; the management strategies adopted; and the effect of CRC participation on research careers. They allow comparisons, for example, of the views of participants from the university and government research sectors (Garrett-Jones et al., 2005b). Data are presented in Table 1 to show those questions that elicited the strongest opinions from the greatest number of respondents.

Responses to open-ended questions in the survey convey the ‘CRC experience’ in the participants’ own words and help to illuminate and interpret their quantitative responses on a range of management issues identified in Table 1. The results offer some new insights into the critical issues raised earlier. In particular, they show considerable consistency in explaining why research personnel join CRCs but considerable differences in the nature of concerns about remaining in the CRC collaborative environment.

5. Rewards and Risk in CRC participation

5.1 The issue of goals

The first theme concerns the goals and expectations of the Australian researchers. Respondents to the survey provided a strong endorsement of the benefits of participation in the CRCs. An overwhelming majority expressed pride in their CRC membership (see Table 1, proposition C1) saw it as complementing their other professional work (C4), and enhancing collaboration (C3). A majority also valued the effect of the CRC on the cohesion of their research team (C2), and as an avenue for technology development that was not otherwise available (C10). Nearly half of the respondents felt that the CRC’s impact on improved project management was beneficial (D5). More tangibly a majority viewed the CRC Program as an important source of research funds (C7) and (for a substantial minority of respondents) the CRCs provided access to essential research facilities in other organizations (C6).

Academic (HE) and government research (GR) respondents differed significantly on two propositions. HE respondents rated professional and administrative support from the CRC as more important than did GR respondents. Further, while both agreed with the proposition that the CRC complemented their professional activities (C4), there was a significant difference in the distribution of responses with the HE respondents being less unanimous in their agreement. We explain these differing responses as reflecting a the more integrated management style typical of public research institutes on the one hand, with those more usually experienced in the university sector.

In the open-ended questions, respondents nominated both material and intangible benefit in membership of their CRC: ‘my association with the CRC has been extremely beneficial and rewarding and I can think of few downsides to my participation in the CRC’ (GR-358); ‘it is one of the best things that has happened for me’ (GR-61); ‘money for continuing research activities - the chase for the dollar!’ (HE-343), with ‘greater stability and longer-term funding’ (HE-337) than available elsewhere; for particular activities such as ‘opportunities for conference attendance/workshop participation not otherwise supported by my organization’ (GO-356); funds for staff and ‘generous PhD scholarships’ (GR-90). ‘I got a real good (well two) student PhDs’ wrote HE-311.¹

However, in contrast to the observations made by Lee’s US study (2000) most benefits reported were intangible, most notably the value of relations with researchers in their own field and in other disciplines: ‘working with peers from other organizations whom I respect’ (CC-118); a ‘widened fraternity of scientists with similar interest/goals’ (GR-263); or simply ‘access to ideas’ (GR-307). These contacts were either unavailable through their university or research institute or were more difficult to arrange:

opportunity to work within a team with similar research interests and opportunities for cross-fertilisation and collaboration with other researchers. If I weren’t associated with the CRC I would be working mostly in isolation. (HE-222)

Several respondents commented on ‘closer relations with industry’ (HE-152) and provision of a business or commercial focus for their research: one gained a ‘wider view of my research area, especially with respect to application of results in industry’ (OT-140). In short, many respondents saw a significant cost in *not* being part of a

CRC as it provided an otherwise missing element to their ‘scientific context’, including application of their research.

The Australian respondents placed less import on the material benefit of funding (compared to Lee’s US study), probably because research funding in Australian universities (and of course in government labs, which were not surveyed by Lee) is not as wholly dependent on direct grants as are US universities. In particular, our findings strongly endorse Lee’s comment that:

First and foremost, faculty members who participate in industry-sponsored research have their own research agendas ... The most important motivational consideration for them is to complement their academic research agenda. (Lee, 2000, pp. 120-1)

We argue that the extent of consistency in the nature of anticipated reward is an important factor that can underpin the organizational durability of the CRC model.

Our survey also explored a range of propositions about potential problems with membership of a CRC. These included issues such as short-term research objectives or a lack of intellectual challenge in industry-related projects, publication restrictions, isolation from other colleagues who were not in the CRC, distortion of organizational goals or a disjunction between reward systems, and lack of adequate return on investment. Unlike the consensus we found on benefits, there was no widespread agreement by respondents on the problems and risks of participation in CRCs.

A minority of respondents felt any conflict between their ‘home’ employment and the demands of the CRC (D8); that their institutions was subsidising their involvement in the CRC (D7); that there was a degree of ‘lock-in’ to the CRC projects which might restrict an appropriate change of direction by participants (D9); or that industry participants were too intent on short-term objectives (D3).

In contrast, another set of possible issues was *rejected* as important by around half of the respondents and supported by only a small minority. CRC participation had not reduced the respondents’ interaction with other students and research staff (F10); nor had the CRC distorted their organization’s research priorities (D11) nor led to undue competition with their ‘home’ colleagues (D10)). In particular, the proposition that industry projects lacked challenge (D4) was strongly rejected. Responses to other questions on scholarly publication and limiting opportunities for fundamental research (not shown in Table 1) were more equivocal, suggesting that these issues were significant for some participants.

What this tells us is that there are no *overriding* problems in the organization arrangements and management of the CRCs, but that particular issues are important or even crucial for some participants. For example only a small minority of respondents agreed that the CRC had any positive effect on their gaining research council grants (a critical issue for academic researchers) (F12), and over half of the respondents to the question disagreed/strongly disagreed. This was the third question where the responses of the higher education (HE) and government researchers (GR) differed significantly. Further, the HE group slightly disagreed that CRC participation had increased their opportunities for scholarly publication. This leads us to suggest that some HE researchers are experiencing difficulty in reconciling their role within the CRC with the drivers of career advancement in the university and success in peer reviewed academic research council grants (Garrett-Jones et al., 2005b).

5.2 *The issue of trust*

Our second theme concerns the role of trust in respect of the scientific programs and governance of the CRC. While scientific opportunities were the main motivating factors it was threatened curtailment of these opportunities that were perceived as major risks. Comments made in response to the open-ended questions in the survey showed that respondents potentially regard as negative anything – like publication restrictions – which impinged on their research activity and output.

5.2.1 *Trusting administrative procedures*

Managing a complex interorganizational network such as a CRC carries substantial overheads. While we received an equivocal response to the question about whether CRCs were ‘too bureaucratic’ many respondents regarded administrative overheads as both unnecessary and as more onerous than with alternative forms of research support. ‘Transaction costs are very high’ (GR-230) was a typical response when asked about problems with the management of the CRC. Others commented: ‘more forms, more paperwork, more reviews’ (GR-125); ‘there is a large administrative cost linking different institutions’ (HE-141); ‘I was frustrated by how cumbersome the CRC was’ (GR-100); and ‘dual reporting needs’ (GO-164). ‘Compared to an ARC grant, a CRC

has a much greater administrative cost and suffers from the possibility that the funds can be altered through the life of a project' said one academic (HE-141).

We were interested to explore this issue further and to explain why this was so strongly felt. First, respondents saw little benefit flowing back to themselves or their research groups: 'unnecessary forms, timesheets etc. with no management feedback even to project leaders; so seems pointless' (HE-121). Second, the politicking and management distracted them from their main concern of carrying out research: 'massive percentage of funds spent on administration rather than research' (HE-335); 'the CRC reporting requirements strongly impinge on research time and activities' (HE-3). Other comments included: 'too much money spent on "organization" – meetings etc... Not enough for research. CRCs should be about research' (HE-200); or the 'focus is not on research' (HE-254). Ultimately, this could lead to frustration and individual reaction:

'my attempts to maintain an external collaboration tore me apart (double management reporting presentation etc) so much that I am leaving this job with the CRC to take a regular funded position overseas with clean and simple funding provided + 30% salary increase' (HE-52).

In short, there appears little trust in the potential of what are described as burdensome administrative procedures to deliver benefit to the researcher or research project.

Although CRCs are not 'cooperatives' in the sense of being member-based, democratically controlled organizations they start this way, by recruiting voluntary participants in the bid for grant funding. We found that this *cooperative thinking* permeates the participants' continuing expectations. The majority of respondents agreed on the importance of fully representative governance for the CRC (E6), while acknowledging the roles of the CEO and board members in the CRC's success (E5 and E7). In contrast only a minority 'agreed/strongly agreed' that their views were adequately represented on the CRC governing boards (D13) or that they had enough influence over decisions by the CRC (D12). Indeed, a substantial minority of respondents 'disagreed/strongly disagreed' that they had an adequate say. Comments we received showed that the respondents *expect* a strong voice in the strategy and running of the CRC and that they were unhappy when they were not consulted and involved: 'I do not have much say in the affairs of CRC. I know I have the capacity to contribute more but no takers' (GR-31). 'We get told what to do!' (HE-264). This

suggests that a desire for organization ‘engagement’ is frustrated by limited trust that such engagement is achievable.

5.2.2 *Trusting scientific credibility*

Respondents’ comments showed that trust between partners in the CRC is expressed both in terms of *scientific competence* (ability) and *commitment* or intention (integrity/benevolence). Competence expressed itself particularly in respondents’ assessment of the quality of the researchers in the collaboration: ‘this can result in a lot of “B grade” researchers doing quite limited work’ (HE-7); or ‘company members supply their second-level staff’ (HE-121). They were critical of the CRC failing to enrol the best researchers:

The university with the most knowledge may not necessarily be working on the project. Who is doing the work is more likely to be the uni that initiates the proposal (GO-37).

Failings by other partners resulting in ‘competition at the expense of collaboration’ (HE-199) were generally interpreted in terms of the party’s self-interest and lack of commitment, rather than their incapacity: ‘some institutions are NOT “cooperative” ’ said one (HE-253); ‘certain individuals from other academic institutions [forget] that the first “C” stands for cooperative’ (HE-79). Others commented on the ‘failure of some researchers to collaborate openly and fairly’ (HE-386). The above comments suggest a concern that the partners are delivering ‘their best’. Respondents lost faith in their partners when they were: (1) viewed as poor quality researchers, (2) viewed as incapable of delivering knowledge, results or feedback, or (3) seemed to lack commitment to the ethos of cooperation or were perceived to be pursuing their own ends. Two factors commonly mentioned that led to this lack of trust were: (1) inadequate commitment of resources (usually people and money) — either actual or perceived (or unverifiable), and (2) domination of or undue influence on the direction of the collaboration or of the potential rewards. The way that CRCs were structured made it difficult for partners to assess whether each other was ‘pulling their weight’: ‘costing models between partners are wildly different and project budgeting is a major source of mistrust’ (GR-96) said one government researcher. Reneging on commitments was also viewed seriously by an academic respondent: ‘ensuring in-kind contributions match commitments’ (HE-184); ‘commitment of individual staff is low ... and over-ridden by host institution priorities’ (HE-89). ‘Inflexible and one-

sided IP arrangements' (GR-123) were also viewed with distrust as a form of self-interest.

The issue of trust as expressed in the experiences of our CRC research personnel reflects the two dimensions of trust elaborated by Nooteboom (2000): competence and intention. But the findings discussed above suggest both are directed at partner organizations, rather than individuals. The concerns are about who *they* deliver, the extent to which *they* listen to me, or the extent of resources *they* deliver. This may reflect an organizational 'settling-in' issue, as personnel learn to trust or otherwise (through experience). Alternatively, it may reflect a deeper structural problem inherent in bringing together partners with differing organizational cultures and functional domains.

5.3 *Managing careers, rewards and risks*

The third theme that stands out in the literature concerns the ways research personnel are influenced in their career decisions by working in a CRC. A large minority of respondents felt that CRC participation had enhanced their career prospects generally (F7), improved the way they worked with industry partners (F8) and provided a positive influence on redirecting their research (F9). Respondents were more equivocal about whether it had improved their prospects of internal promotion. The HE group slightly disagreed that the CRC had enhanced their prospects for promotion within their university whereas the GR group felt that CRC involvement had slightly benefited their prospect of internal promotion.

Respondents commented on benefit related to their own careers and capabilities in the following terms: assisting with 'career progression' (GR-134); 'greatly increased scope and confidence of use in applying for senior jobs' (HE-272); or for others, 'networking and identification of other commercial/clinical areas have re-focused my research career' (GR-229); 'better understanding of IP management and commercialisation' (CC-360); and 'got me to work more efficiently (to meet deadlines)' (HE-312).

Team cohesion was also mentioned: a 'means of uniting the interests of departmental members who would otherwise have quite disparate interests' (HE-215); and 'the program gives a strong strategic focus for a major research group in [my organization]' (GR-231). Status and recognition within the organization has resulted:

‘a useful lever to get better support within my organization’ (GR-138) commented another.

In summary, respondents generally saw CRCs as very valuable in providing both material and intangible rewards. The material rewards (e.g. funding) were ranked less highly than the less tangible: these latter included improvement in their interaction with the scientific community; the perspectives that researchers in other disciplines and institutions brought to their research; the view of ‘different ways of doing things’ that interaction with commercial firms gave them; or attracting high quality research students to their team. Significantly – in their open-ended responses – they couched the benefits in terms of advantage to their *research group* and their *research careers* rather than to their organization as a whole. Respondents took what we might term a strongly academic, scientific and personal view of the benefits of CRC membership. The importance of the participating partners *vis a vis* the CRC appeared to be secondary to that of the research group and careers of individual participants.

6. Conclusions

In the early stages of the program many CRCs were relatively loose networks, few were legally incorporated. The government now requires the incorporation of almost all CRCs which carries pressures to establish enduring organizational arrangements. How CRC research personnel expect such arrangements to evolve and how they experience the process will be an important factor in determining their organizational durability.

As discussed earlier, previous research has suggested that the nature of the specific technology and commercial objectives of the collaborating partners tend to steer the strategic management approaches. This is also the case for CRCs in Australia. However, our interest has been to reveal more precisely why this is so. We propose that it is the nature of reward and risk for the research personnel and how they manage the balance that will determine the most effective management strategies.

We observe that the basic drivers of collaboration and the benefits reported by research personnel in the Australian CRC are likely to be common among other similar triple helix arrangements. Of the management issues that arise, some will be a

feature of most cross-sector R&D organizations, some will pertain only to the specific arrangements in the Australian CRCs, and some will be restricted to individual CRCs and participant institutions. This is because the degree of homogeneity of goals for participant organizations, the factors affecting the acquisition of trust, and the career risks will vary from centre to centre. For some research staff career risks are greater if employed in some CRCs rather than others, or compared to employment in a traditional academic department. There is also some indication that participation in a CRC carries more of a personal career risk for university researchers than for government researchers. Ultimately it is resolving this sort of cost/benefit dilemma that drives strategic decisions.

The present study was not designed to explore causal relationships between the propositions addressed by our respondents nor the extent to which each may or may not have been formative in driving management strategies and organizational change. Rather, our concern was to draw attention to the expectations and experiences of CRC research personnel and reflect on how these might cement these triple helix structures as an enduring organizational form.

We find that one of the most valued aspects of CRC membership is the extension of research networks and access to new 'research users'. This leads us to support the validity of Dietz and Bozeman's (2005) observation that academic research careers are changing in a fundamental way, not because of the nature of research undertaken but because the centres enable researchers to move in new directions. Working within a cross-sector R&D centre can be a substitute for and perhaps a 'safer' option than actually taking a job within industry, and yet still provide benefits of access to what Dietz and Bozeman (p. 349) call 'new social networks and scientific and technical human capital'. In this way the Australian CRCs provide a platform for negotiating triple helix institutional and organizational management frameworks. To the extent that the outcome of such negotiation becomes institutionally embedded in their organizational structure and successful technology transfer, these centres are likely to become drivers of change in the way universities interact with industry more generally.

Table 1. Selected responses from the survey

No	Proposition	n (1)	Mean score (2)	Agree+ Strongly Agree	Disagree+ Strongly Disagree
C1	I am proud to be associated with the CRC.	368	5.1	79%	4%
C4	My work associated with the CRC complements my other professional activities and responsibilities closely.	362	5.0	78%	4%
C3	The multi-centre model of the CRC enhances collaboration.	362	4.6	69%	12%
C2	Involvement in the CRC improves the cohesion of my research team.	348	4.6	61%	10%
C8	The commercial partners in the CRC give an important focus to my research objectives.	348	4.4	57%	15%
C7	CRC funds are an important source of external finance which my organization uses to leverage other funding.	350	4.4	57%	16%
C10	Engagement in the CRC offers an avenue for bringing technology concepts to fruition that would be difficult to achieve by other means.	344	4.4	55%	15%
C6	The CRC gives me essential access to research facilities and equipment in the other participant organizations.	340	3.9	40%	26%
D5	Commercial requirements for improved project management and agreed timelines are beneficial for researchers in my organization.	330	4.1	49%	13%
D7	My department/institution appears to be subsidising my involvement in the CRC.	322	3.9	45%	27%
D13	My views are adequately represented on the CRC Board and its committees.	341	3.9	45%	23%
D9	It is difficult to change our level of commitment to CRC as circumstances change.	316	3.9	42%	21%
D3	Industry participants in the CRC are too intent on short-term objectives.	350	3.9	36%	21%
D8	My conditions of employment (e.g. workload model, performance agreement) do not adequately reflect the time I need to devote to the CRC.	321	3.8	40%	31%
D12	I feel I have an appropriate degree of influence over decisions made by the CRC.	348	3.7	43%	28%
D4	Industry led research projects in the CRC are not sufficiently challenging.	331	2.9	15%	50%
D2	University partners have too much say in shaping the research directions of the CRC.	359	2.9	11%	46%
(1)	Excluding responses of 'not applicable' and missing values				
(2)	Responses were given values on a scale from 1 (Strongly Disagree) through to 6 (Strongly Agree)				

Table 1. Selected responses from the survey (cont.)

No	Proposition	n (1)	Mean score (2)	Agree+ Strongly Agree	Disagree+ Strongly Disagree
D11	The research objectives of the CRC have distorted research priorities in other parts of my organization.	329	2.8	12%	56%
D10	There is too much competition between CRC staff and others at my institution.	329	2.7	14%	57%
E6	Participants in the CRC need to be fully represented on the Board.	347	4.4	61%	19%
E5	The CEO is the lynch pin of the success of the CRC.	350	4.3	55%	15%
E7	The ability and experience of the individual Board members determine the CRC's success.	350	4.2	48%	14%
E1	My organization has developed a specific management regime for CRCs.	315	3.8	40%	25%
E9	My colleagues in the CRC are more important to me than those elsewhere.	339	2.9	15%	49%
E4	The CRC operates much like any academic department.	354	2.8	13%	46%
E2	Performance measures adopted for the CRC have caused my organization to change the way it reports research outputs.	307	2.8	12%	55%
F2	It is productive for postgraduate students to be supervised jointly by academics and researchers from government research organizations.	352	5.1	83%	2%
F1	It is productive for postgraduate students to be supervised jointly by academic and industry researchers.	350	5.0	78%	4%
F8	CRC participation has improved the way I work with industry partners generally.	341	4.1	43%	16%
F9	CRC participation has been a positive influence in redirecting my research activities.	320	4.1	44%	18%
F7	My work with the CRC has enhanced my career prospects generally.	336	4.1	45%	18%
F10	CRC participation has reduced my interaction with students and research staff outside the CRC.	320	3.0	16%	47%
F12	CRC participation has increased my potential for ARC / NHMRC research grant funding.	252	2.8	15%	52%
(1)	Excluding responses of 'not applicable' and missing values				
(2)	Responses were given values on a scale from 1 (Strongly Disagree) through to 6 (Strongly Agree)				

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Note 1

The key to the respondent codes shown in the text is: CC = CRC employee; HE = Higher Education; GR = Government Research organization; GO = Government other organization; OT = other organization.