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The Triple Helix and institutional change: reward, risk and response in Australian cooperative research centres

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Sub-theme: D4: Managing Triple Helix Relationships and Networks

The Triple Helix and institutional change: Reward, risk and response in Australian Cooperative Research Centres

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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. The Centres are archetypal 'triple helix' structures: highly complex inter-organizational networks involving universities, federal and State (provincial) government research agencies, individual firms, and various industry-led public sector intermediaries.

Over 15 years the CRC has become established as the *dominant organizational model* for cross-sector collaborative R&D in Australia, albeit one that is now being challenged by alternative arrangements for research collaboration. Thus, the CRC program has not only become entrenched in the national research system but is also a driving force in research policy debates. CRCs are widely credited with 'changing research cultures' and promoting increased and more effective cross-sectoral, multidisciplinary and multi-organizational research, technology development and commercialisation. The triple helix, in this form, carries the potential to *transform the character of the public sector institutional participants of the CRCs* – the universities and government laboratories – with significant implications for national innovation policy.

Our study examines the impact of the CRC program at three levels:

1. We assess the experience of public sector researchers and research managers within the CRCs. Until our survey, little empirical evidence existed on how researchers themselves perceived and managed the *risks and rewards of participation* in cross-sector R&D centres in Australia. We consider what drives a researcher to become involved in (and to stay committed to) the complex collaborative environment of a CRC.

2. Based on participants' experience, we then identify the *key management issues* that have arisen within the CRCs and the ways that the public research institutions – universities and government research agencies – have responded to the difficulties of collaboration within the CRCs.

3. Lastly, we briefly speculate more broadly on the *role of the CRCs* in the structure of the research and innovation system, and how our findings might inform policy choices in relation to the organization of collaborative R&D.

2. The Australian Cooperative Research Centres Program

The Australian Cooperative Research Centres (CRC) Program is the largest cross-sector R&D program in Australia, with about A$200 million annually in federal government funding. 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, 158 centres have been established: 100 of these were new, and 58 were formed from existing CRCs (Productivity Commission, 2007). There are currently (2006-07) 57 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). CRCs span a wide range of science, engineering and health fields.

CRCs are fairly typical 'triple helix' arrangements: institutionally distributed organizations that rely on the voluntary cooperation of independent partners within a contractual framework. They involve collaboration between universities, federal and state (provincial) government research agencies, individual firms and various industry-led public sector intermediaries. 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. CRCs, like other industry-linked research centres can 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 firstly 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. Indeed, enhancing collaboration between the CSIRO and the universities in doctoral supervision and shared research facilities was an important founding rationale for the CRC Program. The role of the CSIRO undoubtedly influenced the original structure of the centres, in particular the goal to:

> enable each participating group to retain its separate institutional affiliation, but each Centre to constitute a collaborative integrated research team' (Slatyer, 1993; 1994)

This dominance by the government research sector is changing however. CSIRO has declined as a research performer (at least relative to the universities) (Garrett-Jones, 2007). As its government budget has declined CSIRO has engaged in a more collaborative approach to its own research programs with the establishment of a range of 'Flagship' programs, and its own grants for collaboration with CSIRO.

While Program objectives have from the outset promoted 'the links between research and its commercial and other applications' (Slatyer, 1994), the current objectives have 'drifted significantly' from the original ones (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 not mandatory (Cooperative Research Centres Committee, 1991). While the Program continues an 'academic' (proposal driven) mode of funding awarded on the quality of their research, on their partners and on their strategies for application, 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.[i]

CRCs therefore share many of the features of their counterparts in other countries. They 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.

3. Methods and data

We draw empirical evidence 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) 'Research Culture' 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 comprised researchers and research managers involved either directly as participants in one or more CRCs or indirectly with CRCs (e.g. responsible for managing some aspect of the organization's involvement in the CRC). 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 (a) to develop a structured questionnaire for the survey, and (b) to refine a sampling strategy for the survey. The survey was also informed by related research on the career paths of scientists in Australia (Turpin and Garrett-Jones, 2003; Turpin et al., 2005) and on a review of appropriate research performance indicators for the CRCs (Garrett-Jones and Turpin, 2002).

The survey achieved a 34 per cent response rate. The distribution of the respondents by their institutional affiliation is shown in Table 1. Respondents comprised researchers and research managers from 37 CRCs, most of whom were involved directly as formal participants. The majority (53 per cent) of respondents identified themselves as from the higher education (HE) sector, with 21 per cent from the government research (GR) sector (see Table 1). The respondent set was quite homogeneous: 82 per cent of the respondents were men, 77 per cent held a doctoral degree, and 11 per cent held a masters degree. Two-thirds of the respondents had participated in one

CRC only, while the rest had been involved with between two and seven CRCs.

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. A 'Not applicable' response was also allowed. 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). Information was also collected on the respondents' position, length of time in the CRC and years since graduation. Responses to open-ended questions in the survey convey the 'CRC experience' in the participants' own words (Garrett-Jones et al., 2006) and help to illuminate and interpret their quantitative responses on a range of management issues.

The current paper summarises and extends our main findings from the quantitative and qualitative results of the survey in order to allow comparisons with survey data from other cross-sector R&D collaborations.

Table 1. Demography of survey respondents

Sector of employment	CRC (CC)	Higher Education (HE)	Govern-ment Research (GR)	Govern-ment other (GO)	Other (OT)	Total
Number of respondents	34	196	78	43	19	370
Proportion of respondents	9.2%	53.0%	21.1%	11.6%	5.2%	100.0%
Number of respondents answering open-ended questions	18	108	45	23	12	209
Proportion of respondents answering open-ended questions	8.6%	51.7%	21.5%	11.0%	5.7%	100.0%

4. Results

The results below are drawn firstly from Table 2, which shows the mean score of responses for selected questions in the survey and the proportion of response in the 'Agree/Strongly Agree' and 'Disagree/Strongly Disagree' categories. It excludes responses of 'Slightly Agree' and 'Slightly Disagree'. The table thus shows those questions that elicited the strongest opinions from the greatest number of respondents. Second, we draw upon a previous comparison of responses from government researchers and academics where these differ significantly (Garrett-Jones et al., 2005b). Third, we draw upon comments made by respondents in response to the open-ended questions in the survey (Garrett-Jones et al., 2006) in order to illuminate the findings from the questions in Table 2.

Table 2. 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 2. 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)

4.1 The rewards of CRC participation

As Table 2 shows, respondents provided a strong endorsement of the benefits of participation in the CRCs. An overwhelming majority expressed pride in their CRC membership (Proposition C1 in Table 2), 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 (C5 - not shown in Table 2) as more important that 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.

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)[ii]; '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.

However, 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 organization 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 the their 'scientific context', including application of their research.

We asked several questions on the effects of CRC participation on the career opportunities for individual researchers and research students. Respondents overwhelmingly endorsed as productive the joint supervision of postgraduate students by academic and industry researchers (F1) and by academic and government researchers (F2). A large minority of respondents in Table 2 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 (F6 – not shown). The HE group slightly disagreed that the CRC had enhanced their prospects for promotion within their university (F6) 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 agreed in regarding their participation in 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 bring to their research; the view of 'different ways of doing things' that interaction with commercial firms gave to their research; 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 are taking what we might term a strongly academic, scientific and personal perspective on the benefits of CRC membership.

4. 2 The problems and risks of CRC participation

The survey tested a range of propositions about potential problems with membership of a CRC that had been raised in initial interviews with participants. These included issues such as short-termism 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 common consensus we found on benefits, there was no widespread agreement by respondents on the problems and risks of participation in CRCs.

A substantial minority of respondents in Table 2 felt some disjunct between their 'home' employment and the demands of the CRC (D8); that their institutions was subsidising (inappropriately or appropriately – we are not sure; we *meant* above and beyond their contractual commitment!) 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); and 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 (F11 – not shown), and limiting opportunities for fundamental research (F13 – not shown) were more equivocal, suggesting that there were significant for some participants.

What this tells us is that there are no *overriding* problems in the organization 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 (F12), and over half of the respondents to the question disagreed/strongly disagreed. This was a 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).

4.3 Managing the expectations of participants

The results from the quantitative propositions suggest that in a minority of cases at least the expectations of individual members with regard is not being met by the CRC and its participant organizations. Comments made in response to our 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.

As Lee (2000) observes (p. 132) a sustainable collaboration is one where each partner allows the other to realise their objectives, while also contributing

to mutual goals. We interpret the problems that arise in the management of CRCs firstly in terms of the heterogeneity of the cultures and functional domains involved and the potential for competition between them (Garrett-Jones et al., 2006). For example, the reward structures of the parent organization and the CRC may not be aligned, or scientists may find the commercial imperatives of industry too short-term. Second is a problem of coordination and governance in a multi-institutional environment where the partners and individual researchers essentially remain free-agents.

Below we explore participants' participants' expectations under three headings: transaction costs, governance and conflict, and building and maintaining trust between participants. These are linked as each is susceptible to good or bad management. It is quite possible that the comments of our respondents may focus on the more negative experiences within CRCs. What is worrying however is that a substantial minority of respondents indicated that their organization had not developed a specific management regime for their involvement in CRCs (E1), implying that such issues were not being specifically assessed and addressed.

4.3.1 Transaction costs

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' (D14 – not shown in Table 2), 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. Other 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 wondered why respondents found administration so frustrating and burdensome First, they 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 upon 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).

4.3.2 Governance structures

One reason why inter-organizational networks like CRCs encourage innovation is by bringing together people with a 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 what constitutes 'fair play'. Siegel et al. (2001) (p. 5) succinctly identify the management issue in 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.

We also need to question what is regarded as legitimate competition, collaboration, ownership and reward (Gibbons et al., 1994), and how objectives and strategies are defined and implemented (Steenhuis and Gray, 2006). This raises the question of what is the appropriate balance between trust and 'formal government' (Menard, 2004) required to coordinate cross-sector R&D organizations, and what 'governance' and rules are accepted and enforced.

CRCs are not 'cooperatives' in the sense of being member-based, democratically controlled organizations. But they start this way, recruiting voluntary participants in the bid for grant funding and we found that this *cooperative thinking* permeates the participants' continuing expectations. The majority of respondents in Table 2 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).

In a voluntary alliance like a CRC the participants expect 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 the building of trust within the collaboration.

4.3.3 Building trust

Holland and Lockett (1998) 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 hypothesised to be an explanatory variable for the development of such cooperative behaviour' (p. 606). To Daellenbach and Davenport (2004) 'it reflects the expectation that partners will act competently and recognize and protect the interests of other alliance members'

(p. 189). In R&D, academic science is built on trust in the quality and validity of research performed, which is ensured through public sharing of knowledge (Liebeskind and Oliver, 1998). This raises the questions of how partners are selected (Daellenbach and Davenport, 2004), how participants assess trust and reputation (and its breach), how trust is built and how the risk of opportunist behaviour between partners can be reduced.

Nooteboom (2000) recognizes 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). Daellenbach and Davenport (2004) quoting Williams refer to ability, integrity and benevolence and affect as elements of trust.

What we found from respondents comments is that trust between partners in the CRC was similarly expressed both in terms of *scientific competence* (ability) and *commitment* (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" 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 researcher:

> 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 [forgot] that the first "C" stands for cooperative' (HE-79). Others commented on the 'failure of some researchers to collaborate openly and fairly' (HE-386).

In summary, 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.

If we can summarise the expectations of public sector researchers in our survey it is that: 'CRCs should be truly cooperative, CRCs should be about first class research'!

5. Discussion: Managing expectations in cross-sector R&D centres

The 'culture survey' of attitudes among 370 public sector participants in the Australian CRCs contributes to understanding not only the management issues within CRCs but to the management of cross-sector R&D collaboration in general. As (Lee, 2000) comments:

> With respect to the sustainability of collaboration, empirical research is in short supply. If we are to have a realistic understanding of whether the concept of university-industry collaboration can be a vital and sustainable component of the national innovation system, we need to have a good knowledge base of what each sector is actually getting out of their collaboration.

In comparing the CRC survey results with similar work elsewhere, several factors may be relevant. First is the national and institutional context. As noted, there may be 'local' reasons why cross-sector R&D centres have been established or organized in a particular way. We have already pointed to the importance of the government research sector in the Australian context and the need to accommodate powerful organizations like CSIRO. The Canadian Networks of Centres of Excellence, which have many parallels to the Australian CRCs. were set up in 1988 by the federal government, both independent of the powerful National Research Council and 'enabling the federal government to

circumvent university power and autonomy and provincial jurisdiction' (Atkinson-Grosjean et al., 2001; Fisher et al., 2001). The CRC Program was deliberately setup up as a 'different way' of funding research and was initially set up in the Prime Minister's portfolio, not under either of the research councils or the industry ministry. A 'local' problem which has arisen from these arrangements is the effect of CRC Program funding on access to research council grants. It is difficult for researchers to obtain funding from both sources for projects that are viewed as related.

Second, the precise organizational form of the collaboration is also important. In the early stages of the program, many CRCs were relatively loose networks and unincorporated (i.e. not a legal entity, and unable to enter into contracts for licensing technologies etc). The government now requires the incorporation of almost all CRCs. By comparison with some other university-industry centres, the CRCs do not directly employ or second many of their researchers and do not concentrate their researchers in a single location.

We consider that the basic drivers of collaboration and the benefits reported by public sector researchers in the CRC are likely to be common among all cross-sector R&D centres. Of the management issues that arise, some will be a common feature of 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.

While we have not attempted a census of comparable surveys internationally we briefly review two surveys of university researchers that appear to produce findings similar to own. Several studies examine the value of participation in cross-sector R&D centres for business participants (Adams et al., 2001; Feller et al., 2002). Fewer examine closely the benefits for the university faculty members and government researchers.

As Lee (2000) points out, university researchers would not engage with industry unless they felt that the collaboration brought them significant and important benefits. 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 realised 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.

Most of the collaborations in Lee's study involved a project with a single firm: only a quarter of the faculty members were involved in a formal university-industry research centre. However, Lee's findings on the benefits of collaboration to academic researchers accord quite closely with those from the survey of researchers in the Australian CRCs. The Australian respondents placed less import on the material benefit of funding, 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 lead to strongly endorse Lee's comment:

> 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)

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. 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. 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). What Dietz and Bozeman neglect to infer is that working within such a centre can be a substitute for, and perhaps 'safer'

option than actually taking a job within industry, and yet still provide benefits in terms of access to 'new social networks and scientific and technical human capital' (p. 349). This is borne out by the frequent comment of the researchers in our study that one of the most valuable aspects of CRC membership is through extension of their research networks and access to new networks of researchers and research users. Dietz and Bozeman's, (2005) observation that academic research careers are changing in a fundamental way appears valid. Our work provides support for their evidence that 'the opportunity provided to build S&T human capital' (p.362) is one of the attractors of the new career path.

6. The role of CRCs in the research system

If the important contribution of cross-sectoral collaborative R&D centres is to be retained without damage to the science and innovation system as a whole the 'academic' and 'scientific' foundations of innovation which underpin the expectations of our respondents must be nurtured not eroded. This requires management and policy initiatives which better recognise and sustain the knowledge resources – the scientific networks and careers of individual researchers – on which CRCs rely.

Our survey reveals no overriding management concerns with the CRCs. However, the critical comments made by a substantial number of our respondents in relation to management of their collaboration imply room for improvement in the management of some CRCs. Many CRCs are clearly 'getting it right' for the great majority of their participants and could promulgate 'best practice' for other centres. The management of CRCs involves not only the governance of the CRC itself but an articulation with the practices of the participant organizations. We therefore view with concern the finding that many organizations had not developed a specific management regime for their involvement in CRCs.

Finally, the national policy debate on the role of CRCs in Australia is proceeding without a proper consideration of what drives and sustains the public sector participants. A recent report from the federal government's influential Productivity Commission concludes '[t]he complete shift to industry-focused CRCs is inappropriate' (Productivity Commission, 2007). However, it

draws this conclusion not out of any expressed concern for the scientific basis of CRCs, but because 'current costsharing arrangements do not appear to reflect the distribution of benefits from the program, with potentially large subsidies available to business partners'. This debate has played out before. Ten years ago the 'Mortimer Report' was especially critical of schemes which produced 'private benefit' for firms and recommended the termination of CRCs which fell into this category and retention of the CRC Program only for 'public good' research (Review of Business Programs, 1997). The government largely rejected Mortimer's prescriptions for CRCs.

Similarly, the Commission recommends that 'given high associated compliance costs under current arrangements, a complementary arrangement to support smaller-scale and short-term collaborations between groups of firms either independently or with universities and public sector research agencies should be introduced' (Productivity Commission, 2007). While this is an attempt to address the issue that we have identified of high transaction costs within CRCs, the Commission again fails to consider what alternative models of cross-sector R&D collaboration (and Australia has several other schemes) can appropriately support the expectations of the researchers involved.

Rather than relying on policy prescriptions based solely on econometric analyses policy makers in Australia need to recognise that sustenance of the 'knowledge resource base' that underpin CRCs is a key concern. Once this is accepted, learning from International experience with alternative forms of sponsorship of 'lighter' cross-sector collaboration – such as prestigious, industry-linked professorial chairs, or program such as the NSF GOALI scheme that support personnel exchange between universities and industry – may also be instructive.

References

Adams, J. D., Chiang, E. P., and Starkey, K. (2001). Industry-University Cooperative Research Centers. **26,** 73.

Atkinson-Grosjean, J., House, D., and Fisher, D. (2001). Canadian Science Policy and Public Research Organisations in the 20th Century. *Science Studies* **14(1),** 3-25.

Cooperative Research Centres Committee. (1991). Cooperative Research Program Guidelines for Applicants: Round Two Applications. AGPS, Canberra.

Daellenbach, U. S., and Davenport, S. J. (2004). Establishing Trust during the Formation of Technology Alliances. *The Journal of Technology Transfer* **29,** 187.

Dietz, J. S., and Bozeman, B. (2005). Academic careers, patents, and productivity: industry experience as scientific and technical human capital. *Research Policy* **34,** 349-367.

Diment, K., and Garrett-Jones, S. (2007). How demographic characteristics affect mode preference in a postal/web mixed-mode survey of Australian researchers. *Social Science Computer Review* **25**.

Feller, I., Ailes, C. P., and Roessner, J. D. (2002). Impacts of Research Universities on Technological Innovation in Industry: Evidence from Engineering Research Centers. *Research Policy* **31,** 457-474.

Fisher, D., Atkinson-Grosjean, J., and House, D. (2001). Changes in Academy/Industry/State Relations in Canada: The Creation and Development of the Networks of Centres of Excellence. *Minerva* **39,** 299-325.

Garrett-Jones, S. (2007). Marking time? – The evolution of the Australian national innovation system, 1996-2005. *In* "Science, Technology Policy and the Diffusion of Knowledge: Understanding the Dynamics of Innovation Systems in the Asia-Pacific." (T. Turpin, and V. V. Krishna, Eds.). Edward Elgar, Cheltenham.

Garrett-Jones, S., and Turpin, T. (2002). "Measuring the Outcomes of the CRC Program: A Framework - Final Report." Dept. of Education, Science and Training, Canberra.

Garrett-Jones, S., Turpin, T., Burns, P., and Diment, K. (2005a). Common purpose and divided loyalties: the risks and rewards of cross-sector collaboration for academic and government researchers. *R&D Management* **35,** 535-544.

Garrett-Jones, S., Turpin, T., and Diment, K. (2005b). Different cultures, different perspectives: the experiences of academic and government researchers in collaborative R&D centres. *In* "The R&D Management

Conference 2005: Organising R&D Activities - a Balancing Act." Scuola Superiore Sant' Anna, University of Pisa&Politecnico di Milano, Pisa, Italy.

Garrett-Jones, S., Turpin, T., and Diment, K. (2006). Are R&D Collaborators Bound to Compete? Experience from Cooperative Research Centres in Australia. *In* "22nd Colloquium of the European Group for Organizational Studies (EGOS), 'The Organizing Society' " (D. Knoke, A. Oliver, and M. Meeus, Eds.). European Group on Organizational Studies, Bergen, Norway.

Gibbons, M., Limoges, C., Nowotny, H., Schwarzman, S., Scott, P., and Trow, M. (1994). "The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies." Sage, London.

Holland, C. P., and Lockett, A. G. (1998). Business Trust and the Formation of Virtual Organizations. *In* "31st Annual Hawaii International Conference on System Sciences." pp. 602-610. IEEE.

Howard Partners. (2003). "Evaluation of the Cooperative Research Centres Programme." Department of Education, Science and Training, Canberra.

Lee, Y. S. (2000). The Sustainability of University-Industry Research Collaboration: An Empirical Assessment. *The Journal of Technology Transfer* **25,** 111-133.

Liebeskind, J. P., and Oliver, A. L. (1998). From Handshake to Contract: Intellectual Property, Trust, and the Social Structure of Academic Research,' in.*In* "Trust Within and Between Organizations." (C. Lane, and R. Bachmann, Eds.), pp. 118-145. Oxford University Press, New York.

Menard, C. (2004). The Economics of Hybrid Organizations. *Journal of Institutional and Theoretical Economics - JITE* **160,** 345–376.

Nooteboom, B. (2000). Institutions and Forms of Co-ordination in Innovation Systems. *Organizational Studies* **21,** 915-939.

Productivity Commission. (2007). Public Support for Science and Innovation. Productivity Commission, Melbourne.

Review of Business Programs. (1997). "Going for growth: business programs for investment, innovation and export (Mortimer Report)." Dept. of Industry, Science and Tourism, Canberra.

Siegel, D. S., Thursby, J. G., Thursby, M. C., and Ziedonis, A. A. (2001). Organizational Issues in University-Industry Technology Transfer: An Overview of the Symposium Issue. **26,** 5.

Slatyer, R. O. (1993). Cooperative research centres: The concept and its implementation. *In* "Research Grants Management and Funding." (F. Q. Wood, and V. L. Meek, Eds.), pp. 121-129. Anutech, Canberra.

Slatyer, R. O. (1994). Cooperative research centres: The concept and its implementation. *Higher Education* **28,** 147-158.

Steenhuis, H.-J., and Gray, D. O. (2006). Cooperative research and technology dynamics: the role of research strategy development in NSF Science and Technology Centres. *International Journal of Technology Transfer and Commercialisation* **5,** 56-78.

Turpin, T., and Garrett-Jones, S. (2003). A Missing Variable: Evaluating the Institutional Impact From Participating in Government supported Cross-Sector R&D Programs. *In* "Evaluation of Government Funded R&D Activities." ZEW-CEER, Vienna, Austria.

Turpin, T., Garrett-Jones, S., and Diment, K. (2005). Scientists, career choices and organisational change: Managing human resources in cross-sector R&D organisations. *Journal of the Australian and New Zealand Academy of Management* **11,** 13-26.

Notes

[i] http://backingaus.innovation.gov.au/2004/commercial/crc.htm

[ii] The key to the respondent codes shown in the text can be found in Table 1.