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Managing competition between individual and organizational goals in cross-sector research and development centres

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Abstract Research of potential socio-economic value is commonly conducted within cross-sector (government, university, business) centres. Success depends on partners whose objectives and strategies may converge or compete. Yet little empirical evidence exists on: (a) how individual researchers perceive the benefits of their participation, (b) how far the structures and functions of particular collaborative R&D centres coalesce around of researchers' expectations and, (c) what problems arise for researchers who opt for a 'second job' in the centre. The paper presents a qualitative analysis of a survey of respondents from public sector organizations involved in Australian Cooperative Research Centres. A novel frame for analysing these data is the study of inter-organizational relationships (IOR). We use the perspective of the individual research scientists to illuminate the important management issues of trust, governance, and competition between functional domains, which emerge from IOR and which have been inadequately recognised in the context of collaborative R&D centres. The findings have implications for the management and of the centres, for the careers of research scientists and for public policy.

Keywords Cross-sector R&D · Research organization · Research policy · University-industry linkages · Inter-organizational relations · Australia · Cooperative Research Centres

JEL Classification O32 · O38

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1 Introduction

The unprecedented growth in cross-sector (industry–academic–government) collaboration in research and development (R&D) reflects far-reaching changes in the relationship between sciences, notably in the organizations that carry out research. R&D is increasingly being carried out in organizational forms, such as university–industry collaborative research centres, which are built around cross-sectoral and trans-disciplinary teams with well-defined socio-economic objectives in mind.

Two influential models seek to explain the institutional configuration of cross-sector R&D observed: the 'triple helix' model of university–industry–government relations (Etzkowitz and Leydesdorff 1997) and the 'Mode 2' knowledge production of 'science in the context of application' which (Gibbons et al. 1994) contrast with 'Mode 1' traditional science pursued within discipline-based structures like university departments. Critics of these models argue that they reflect nothing new: that academic research has always been heterogeneous in character and comprised elements of trans-disciplinary and strategic research (Rip 2000; Ziman 1991). In our view, this overlooks the significance of the new forms of collaborative organization, their scale and complexity, their novelty (e.g., as distributed or virtual centres) and their effect on existing institutions like university departments and disciplines (Turpin and Garrett-Jones 2000). We consider the models limited because they fail to explain how the new cross-sector R&D organizations are best structured and sustained and how the process of renegotiation takes place between the centres and the member institutions.

Academic staff involved in collaborative research centres in the US hold continuing appointments in a university department (Boardman and Bozeman 2007) or, in Australia, may be researchers with government institutions. Effectively they hold multiple jobs or roles. Through their affiliation with the centre, these staff not only accept additional responsibility, but responsibilities which may sit incongruently with those in their home institution. This arrangement parallels Merton's observation about the competition for resources and potential incompatibility between the multiple roles involved in a position as a university professor or scientist in a research organization (Merton and Barber 1976). Examples of situations that might lead to work incompatibility (Boardman and Bozeman 2007) are the different reward and incentive systems in the centres by comparison with academic departments, or divergences in research interests between the problem-oriented centre and the discipline-based academic department. Shove (2000) speaks of 'a multiplicity of research regimes' and 'a range of settings each of which interprets, values and rewards research differently'.

Life in the 'triple helix' has been portrayed in terms of choices made by individual researchers in the extent they wish to commit to 'involvement in multiple worlds' (Henkel 2004). The social scientists surveyed by Shove (2000) were 'struggling with the stresses and strains of simultaneously inhabiting different worlds'. Gulbrandsen (2000) sees it not as a question of resolving tensions (e.g., between scientific excellence and utility), but balancing them—constructing various individual strategies of 'portfolio management', as Shove (2000) puts it. Gibbons et al. (1994: 48) argue that universities and government laboratories have entered 'the game of dynamic competition', where 'knowledge resources are held in different organizations and can be shifted between environments which are at one moment competitive and at another collaborative'. These environments are not discrete, but are populated by actors who 'move back and forth', for example, researchers who work concurrently in a university department and a centre. While acknowledging the movement of researchers, Gibbons et al. (1994: 41) on the other hand talk about the 'strain

of multifunctionality' as an *institutional* challenge affecting, for example, universities and professional societies rather than individuals.

Recent work by Boardman and Bozeman (2007: 431) interprets the 'multiple and perhaps conflicting demands of multiple allegiance' within the 'unusually complex institutional environment of [centres]' (Boardman and Bozeman 2007: 440). It thus covers similar ground to the current paper. Boardman and Bozeman's contribution is to use role theory to examine these tensions and to extend the idea of individual 'role strain' or 'role conflict' within a single organization (Box and Cotgrove 1966)[1] to encompass the 'centre-induced role strain' that may be produced by working across organizations. As in the current paper's discussion of 'functional domains' Boardman and Bozeman (2007: 439) examine problems at different organizational levels (e.g., within-department or within-centre role strain versus centre-department role strain). Rightly Boardman and Bozeman play down Box and Cotgrove's (1966) notion of 'strain minimisation' as the prime individual response, pointing out that, as in our study, participants voluntarily take on the challenge of working within the setting of a cross-sector research centre. In conclusion Boardman and Bozeman quote NSF's Erik Bloch in saying 'it's up to the individual' whether or not he/she is prepared to work within a cross-sector R&D centre and propose a focus on the 'personnel management and policy issues' provoked by such centres.

We acknowledge the importance of centres for individual researcher's career choices (Turpin et al. 2005) and the salience of the voluntary/cooperative aspect of participation in centres. But, in our view, managing the competing demands within cross-sector centres cannot be relegated to a problem solely for the individual, or 'a side effect requiring clarification and remedy' (Boardman and Bozeman 2007: 437). Rather it reflects a central and deliberate feature of the complex and hybrid institutional environment of collaborative research centres and must be specifically addressed when designing management structures and regimes for the centres.

One explicit goal of policies which institutionalise cross-sector multidisciplinary research, including Australia's Cooperative Research Centres (CRC) Program, is to challenge the conservative norms and cultures of academic disciplines, universities, research organizations and firms by exposing them to each others' cognitively different worlds. It is long recognised that productive research teams require a balance between challenge and security, a range of 'creative tensions' whose dimensions include the relationships between science and its application, and between individual independence and organizational coordination (Pelz and Andrews 1976). As Nooteboom (2000) points out, one reason why inter-organizational networks encourage innovation is by bringing together people with a greater 'cognitive distance' (CD) between them—an idea akin to the 'creative tensions' of Pelz and Andrews (1976). Leydesdorff and Etzkowitz (2001) 'expect[s] differences of perspective, leading to creative interactions in which the participants can transcend the *idées reçues* of their respective organizations'. Thus the goal is to promote creativity without undermining the traditional strengths that the participants bring to the collaboration, such as commercial focus, mission-orientation or intellectual rigour.

Recent empirical work by Cummings and Kiesler (2005, 2007) examines coordination and the trade-off between innovation opportunities and coordination costs within multi-university research collaboration. The authors find a direct correlation between coordination activities, which include 'relationship development' (Cummings and Kiesler 2005: 704) and project outcomes, but conclude that coordination costs are a significant barrier to

[1] Role strain results from 'a lack of congruence between the needs and interests of the individual and the demands of the organization' (Box and Cotgrove 1966: 24).

collaboration. Their arguments draw upon several institutional-based views of the problem: organization theory and forms of coordination, the knowledge-based view of collaboration between firms, and theoretical and empirical studies of distributed work practices (Cummings and Kiesler 2007) and social network research (Cummings and Kiesler 2005). They conclude that the trade-off is a general issue within distributed innovation systems.

Use of the role theory lens implies that independent variables related to individual scientists' values and expectations will be relevant. Indeed Box and Cotgrove (1966) originally proposed a trichotomy of types of scientist which they linked to particular occupational choices. Neither we nor Boardman and Bozeman (2007) compare the views of researchers working within centres with a similar group of researchers who avoid centre-based research. What does emerge, however, is a rather surprising commonality of views among the centre-based researchers. We have found few significant differences in the responses of academic and government researchers to the quantitative questions in our survey (Garrett-Jones et al. 2004). Likewise, Boardman and Bozeman fail to find any relationship between role strain and individual variables like gender, tenure status or academic discipline. They do however see organizational relations factors (such as the formality of relations, or the closeness of ties) as correlated with role strain.

What emerges from the empirical literature on R&D centres is: (1) an agreement that inhabiting multiple roles, domains or worlds creates new or aggravated sources of tensions and problems; (2) an understanding that participation involves a trade-off between the benefits and costs of membership, the latter including costs of relationship-building and coordination; and (3) that organizational structures, such as degree of bureaucratic or participatory management (Chompalov et al. 2002) and activities, such as extent of communication (Cummings and Kiesler 2007) are demonstrably pertinent to the success of collaborations. However, the literature reveals ambivalence about the relative contribution of individual and organizational factors in responding to these challenges. Participation in cross-sector centres is voluntary and may be explained in terms of personal attitudes and individual choice. But the values held by researchers do not necessarily help in distinguishing between those who thrive in cross-sector research environments and those who do not. Forms of organization, which vary with factors such research field, scale of the collaboration and geographic dispersion, also influence collaborative outcomes. This leads Elzinga (2004: 8) to be less than sanguine about 'Mode 2' and 'triple helix' collaborations, observing that 'democratic corporatism' and 'convergence and agreement [are emphasised]…while potential conflict and exclusion mechanisms are toned down, giving rise to a picture of smooth and peaceful collaboration across institutional borders'. Are these tensions unique to CRCs, or do they arise in other forms of inter-organizational collaboration?

1.1 Cooperative Research Centres as inter-organizational relationships

Cross-sector collaborative R&D centres (such as the Australian CRCs and their counterparts in other countries) represent a new form of research organization. The growth of these centres parallels the emergence of inter-organizational relationships (IOR) in business, notably the alliances of firms aimed at introducing technologically based new products and services in markets. We can regard the centres as a class of inter-organizational relationship, which has been variously termed 'hybrid organization' (Menard 2004; Lamb and Davidson 2004; Minkoff 2002), 'virtual organization' (Handy 1995; Hatch 1997; Holland and Lockett 1998; Jarvenpaa and Leidner 1999) or form of 'cooperative network' (Castells 2001; Handy 1993). As Chompalov et al. (2002) observe, network forms of organization

have been widely studied for firms, non-profit and government organizations, but less so for inter-organizational R&D arrangements.

The typology and dynamics of these hybrid organizations remains poorly understood. Menard (2004: 345–347) notes that hybrid organizations may be thought of as a 'heterogeneous set of arrangements' that 'rely neither on markets nor hierarchies for organizing transactions'. He argues that hybrid organizations 'form a specific class of governance structures' (Menard 2004: 368), which share common characteristics and problems. These include the difficulties of coordinating contractual arrangements that involve autonomous partners, particularly where a high degree of uncertainty about the value of the products of the collaboration is involved; and the fact that they are neither driven solely by market considerations, nor subject to the command and control of a single organization (Menard 2004).

The first issue in managing voluntary or loosely contractual relationships is therefore managing autonomous partners. If the collaboration is to arise and be sustained, all participants must see some benefit that they could not achieve more easily alone or in some other way, otherwise there is a 'credible threat' of unilateral action, for example, that they will unilaterally withdraw (Oster 1994: 247). This raises the question of how partners (individually or institutionally) initially assess and continue to monitor the benefits and costs of their participation in cooperative R&D.

The notion of risk and trust in IORs is well expounded in the literature. Holland and Lockett (1998: 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 hypothesised to be an explanatory variable for the development of such cooperative behaviour'. Nooteboom (2000: 918) recognises two elements of what he calls 'the slippery notion of trust'. These elements are *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 group or organization).

Hybrid organizations not only *combine* different organizational behaviours, but operate *across* broad and complex organizational environments. In this sense they are truly 'boundary spanning' (Steenhuis and Gray 2006). Minkoff (2002: 381) makes the crucial observation that 'hybrid organizations operate in multiple functional domains', compared with organizations that operate within 'clearly defined technical and institutional boundaries'. Other authors term these functional domains 'sub-cultures' or 'societal sub-systems'. Nowotny et al. (2001) talk about hybridisation also in the sense of combination of scientific disciplines and multidisciplinarity. This allows the idea that different functional domains can exist *within* and *across* the partner organizations as well as *between* them. As Ziman (1991) shows, universities are quite unlike firms in this regard because of their highly segmented components—departments, research centres and so on; and the 'blurred line' between academics acting as university staff and performing as independent entrepreneurs. We suggest that Minkoff's term 'functional domains' can be applied to encompass and extend these 'different worlds' and 'research regimes' posited by Shove (2000) and Henkel (2004). The idea of competition between functional domains thus provides an institutional counterpart to 'role strain' at the individual level.

A wide CD between the participants has the merit of bringing in new ideas, but also creates problems of mutual 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'. 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. It also brings up issues such as what is regarded as legitimate competition, collaboration, ownership and reward (Gibbons et al. 1994), and how the objectives and strategies of the centre are determined and implemented (Steenhuis and Gray 2006).

What the IOR literature brings to the discussion is: (1) an emphasis on the autonomy of partners, and therefore on the benefit-cost equation from each partner's perspective; (2) the extension of the idea of competing roles (at the individual level) into that of competing functional domains (at the level of the group or organization); (3) questions related to trust and reputation (and its breach), how partners are chosen, how trust is assessed and built, and how the risk of opportunist behaviour between partners can be reduced; and (4) questions concerning alternative forms of governance for collaborative research and particularly the choice between consensual or centralised, directive management.

1.2 Propositions

The current paper explores the contention that lessons learnt from the management of IORs generally are of help in understanding the interactions between the partners in cross-sector R&D collaboration, including the experience of individual researchers, the effect on existing institutions like academic departments and disciplines and the structure and governance of the collaborative centre itself.

Using qualitative data from a survey of Australian CRC participants we analyse participants' views on the attractions and problems of working within these new organizations. We structure the findings and discussion under three themes:

(1) What drivers and benefits of centre participation are reported by participants? What motivates researchers to found, join and remain in cross-sector R&D centres?
(2) How are centre identities negotiated and agreed? What values do participants bring to the negotiation; how important is trust between participants and how is it defined? How do participants view the governance structures of the centres; how are boundaries and rules determined and enforced?; and
(3) How are divided loyalties and competing demands perceived and resolved? What causes researchers to become dissatisfied or disillusioned with these centres, and how do they respond?

Some themes were explicitly covered in the structured questionnaire, while others emerged from the analyses of the participants' open-ended responses (see Sect. 2.2 below). We questioned respondents directly on the benefits and problems of centre membership, on governance and on divided loyalties, for example, whereas the themes on identity, values, trust and the resolution of role strain were synthesized from the respondents' comments. We chose to explore each of these themes further because of their resonance with issues raised both in the research policy and IOR literature and their bearing on the management of cross-sector R&D centres. The paper first introduces the cross-sector R&D model embodied in the Australian CRCs. It then describes the methods used in the survey of CRCs participants and in analysing the responses. In the following sections we analyse the opinions of respondents in relation to each of the three themes. Finally we consider implications for the management of the CRCs, and their broader validity for cross-sector R&D organizations.

2 Data and methods

2.1 The Australian Cooperative Research Centres Program

The results reported in this paper come from a 'research culture' survey of respondents ($n = 370$) from public sector organizations involved in the management and conduct of collaborative R&D in the Australian CRC. The paper presents a qualitative analysis of the comments from 209 of these respondents who chose to answer 'open ended' questions in the survey.

The CRCs are geographically and institutionally distributed organizations that rely on the voluntary cooperation of independent partners within a contractual framework. There are currently about 50 CRCs in operation, covering a wide range of industrial-oriented research (such as polymers or advanced automotive technology) and national interest research (such as Aboriginal health or greenhouse accounting), each funded for an initial 7 year term. 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 are highly complex inter-organizational networks. For example, the CRC for Polymers combines 11 participant companies in the plastics industry (two of which are spin-offs from the CRC), two large federal government research agencies, 10 universities, a state government department and another independent cross-sector R&D centre.

2.2 Methods

A written, mixed-mode (postal and web-based) survey (Diment and Garrett-Jones 2007) targeted a non-random but representative sample of about 1,100 staff involved in the management and conduct of CRC-based research in public sector organizations—i.e., excluding industry partners which were the subject of a parallel study (Fulop and Couchman 2006). The survey achieved a 34% response rate. Respondents comprised researchers and research managers from 37 CRCs, most of whom were involved directly as formal participants. The majority (53%) of respondents identified themselves as from the higher education sector, with 21% from the government research sector (see Table 1). The respondent set was quite homogeneous: 82% of the respondents were men, 77% held a doctoral degree, and 11% 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. Analysis of these responses permitted 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 (Garrett-Jones and Turpin 2007) and comparison between the views of academic and government researchers (Garrett-Jones et al. 2004). The final question (optional) in each section allowed an open-ended response to the themes of benefits, problems, administration issues and impact on career. Of the respondents 206 (or 56%) chose to respond to one or more of the optional questions. There was no significant difference between the group of respondents who answered the open-ended questions and the full respondent group in terms of where they were employed

Table 1 Demography of survey respondents

Sector of employment	CRC	Higher education	Government research[a]	Government other[b]	Other[c]	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	206
Proportion of respondents in category answering open-ended questions	52.9%	55.1%	57.7%	53.5%	63.2%	55.7%

[a] A government organization whose primary purpose is research

[b] A government organization whose primary purpose is other than research

[c] 'Other' includes currently unemployed respondents, private consultants, staff employed by business subsidiaries of the public organizations etc.

(Table 1). The respondents did not seem unduly constrained by our themes and furnished comments on a wide range of issues.

Every response was analysed with the assistance of the QSR NVivo 2 software. NVivo is a database management program designed for exploring complex unstructured qualitative data. The program permits dynamic coding (establishment of categories and the tagging of particular passages or words in the responses to one or more of these categories) of selected passages from the responses and querying of the data by category, by respondent and by other independent variables.

Analysis was framed initially under the four themes of the survey: benefit, problems, management strategies and career impacts (positive and negative). We then created hierarchies of nodes in NVivo to capture and categorise all of the respondent comments from the survey that we deemed material, as in Table 2. One of the benefits of the program is that these nodes are dynamic and can overlap: a respondent's comment, or part thereof, can be referenced by multiple nodes. This allowed us to explore responses both from the perspective of the individual respondent and their institutional affiliation, and the perspective of institutional setting or functional domain to which they attributed particular benefits or problems of centre membership. We then extracted views that seemed relate to the issues identified from the literature: the cost/benefit determination made by respondents—how they described the benefits of participation and decided that the benefits outweighed the costs; different forms of trust and how they were assessed; and governance of the centres and causes of and responses to dissatisfaction.

The respondents' comments reported here have been chosen to reflect the range of views reported in the survey and to balance disparate views where these exist. While it is possible that the more disaffected respondents may 'self-select' and thus bias the sample, we note a wide spectrum of positive views also.

3 Findings

3.1 Drivers of centre participation

The motivating factors underlying individuals' choices to join CRCs concerned mainly intangible benefits. These included widening the range of scholars available for collaboration, better access to industry partners and working with a larger cohort of scholars with

Table 2 Example of hierarchical 'nodes' used in NVivo coding of responses

1. Problems
1.1. Between partners
1.1.1. Trust
1.1.1.1 Competence
1.1.1.2. Intention/opportunism
1.1.1.2.1. Attitude
1.1.1.2.2. Funding/resources
1.1.1.2.3. Control/domination
1.2. Within home organization
1.2.1. Resources/time
1.2.1.1. Lack of support
1.2.1.2. Competition for resources
1.2.2. Rewards
1.2.2.1. Lack of recognition
1.3. In management of CRC
1.3.1. Transaction costs, bureaucracy
1.3.2. Burden of reporting, dual reporting
1.3.3. Conflict with norms of science
1.3.3.1 Publication restrictions
1.3.3.2. IP ownership

similar scientific interests. These expectations were expressed in similar terms by almost all participants, irrespective of their sectoral background. In short, the expectation of intensive research cohesion around a group of researchers from government, universities and industry was the main attractor for most participants in the survey. Respondents reported significant benefits in membership of their CRC. Indeed, two government researchers were effusive: 'my association with the CRC has been extremely beneficial and rewarding and I can think of few downsides to my participation in the CRC'; and 'it is one of the best things that has happened for me'.

The CRCs provided material resources; both financial and human. Senior academic respondents nominated 'money for continuing research activities', with 'greater stability and longer-term funding' than available elsewhere. Government researchers mentioned funds for staff and 'generous PhD scholarships' and for research communication activities such as 'opportunities for conference attendance/workshop participation not otherwise supported by my organization'.

Most benefits identified were intangible and came from the interaction with partners in the CRC. Comments praised the value of peer relations with researchers in their own field: 'membership in a group of otherwise disparate scholars'; 'a spirit of belonging to a broad research community'; or simply 'access to ideas'. These contacts were either unavailable through their home organization, or more difficult to arrange: 'If I weren't associated with the CRC I would be working mostly in isolation' said a postdoctoral researcher. Some researchers reported a significant cost in *not* being part of a CRC, because it provided an element that was otherwise missing from the respondent's 'scientific domain'.

The CRC not only embedded the researchers in their peer groups, it also helped them to broaden their research perspectives through positive interaction with scientists working in other disciplines. For one academic environmental scientist, it 'opened up my eyes to a different approach to research'.

Other benefits nominated by both academic and government respondents were directly related to their own careers and capabilities. This ranged from employment to assisting with career progression: 'greatly increased scope and confidence…in applying for senior jobs'; or other personal goals: 'promised opportunities to remain in a rural town'; 'spin-off company giving broad experience and consulting work post-retirement from the university and CRC'. Involvement with the CRC led to new personal skills, notably in management and leadership. It 'allowed me to fulfil or expand [my] scientific management aspiration' explained a government agricultural scientist; gave one respondent a 'better understanding of IP management and commercialisation'; and for an academic, 'got me to work more efficiently (to meet deadlines)'.

Comments also related to consolidating or changing participants' research direction. Several respondents commented on the value of closer relations with industry, and provision of a business or commercial focus for their research. One late-career researcher gained a 'wider view of my research area, especially with respect to application of results in industry'. The CRC allowed one ex-government researcher to 'continue to undertake research in the same field as that for my PhD'. For a senior government researcher, 'networking and identification of other commercial/clinical areas have re-focused my research career'.

Benefits for research groups within the partner organizations were also identified. CRC involvement provided a 'means of uniting the interests of [university] departmental members who would otherwise have quite disparate interests'. For one government researcher, the 'program [gave] a strong strategic focus for a major research group in [my organization]'. Others found that improved status and recognition had resulted: 'a useful lever to get better support within my organization'; and 'the CRC has increased my visibility among peers and industry partners'.

The benefits identified by respondents were varied, but they overwhelmingly related to the domain of 'science' and the quality of the research they personally, and within their immediate research groups, were able to do. They valued the improvement in their interaction with the scientific community, the perspectives that researchers in other disciplines and institutions brought to *their* research, and the view of 'different ways of doing things' that interaction with commercial firms gave *to their research*. They were closely aware of the personal benefits to them as career researchers, for continuing the kind of work they found productive, extension of their skills and career prospects, and their standing within their institution and the scientific community. While they valued the cohesion that the focus of the CRC work gave to their research group or department, they rarely expressed benefit in terms of advantage to their organization *per se*. Their perspective of benefit was almost solely on what we might term the 'scientific' and 'academic' domains.

This 'science-based' view of the benefits also influenced our respondents' views of the costs of participation. Broadly, anything that distanced them from the network of high quality researchers, or diverted them from their own research, was seen as a cost. These costs emerged when we looked at the role of trust and competition in developing a cohesive group identity for the centre.

3.2 Negotiating centre identities

Like many new organizational structures newly established CRCs undergo a period of organizational identity building. Drawing the constituent elements into a coherent organizational culture is, in a sense, a community activity. Building trust, negotiating priorities,

and steering a common course through potential rewards and risks are all part of this process. The impression of the centres received from the respondents' comments is one of a rather fragile coalition of interests. The 'glue' that holds this collaboration together is firstly mutual trust between the participants, and, second, a range of formally agreed activities and rules.

3.2.1 Perceptions of trust

Both trust in competence and trust in intention (Nooteboom 2000) were important in the minds of our respondents when describing relations with their partners in the CRCs. Competence expressed itself particularly in respondents' assessment of the quality of the researchers in the collaboration:

> Inconsistent calibre of researchers—the CEO was not in a position to tell research agencies that their researchers were inappropriate (because of their skills or performance). The CRC had to adopt a 'lowest common denominator' approach. It was slowed down by its weakest members.

In the view of another respondent, 'company members supply their second-level staff'. Initial selection of partners was seen as crucial, and yet a government respondent made the criticism that the quality of the researchers appeared to be a secondary consideration:

> 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[versity] that initiates the proposal.

Respondents also identified partners as unable (rather than unwilling) to manage themselves to deliver appropriate inputs, rather than lacking in scientific competence: 'lack of vision by industry partners' said a senior manager of the CRC, and 'very little feedback on the adoption of research outcomes by industry/partner agencies/stakeholders' commented a senior government researcher. Criticising a specific government agency, one respondent claimed:

> …[named agency] is the bureaucracy-laden, meetings/talkfest focused organization, not the CRC; CRC staff are too busy doing what industry actually wants and thereby get another term to waste the amount of resources [named agency] staff do.

Generally, however, failings by other partners resulting in 'competition at the expense of collaboration' were interpreted in terms of the party's self-interest and lack of commitment, rather than their incapacity. Both individuals and organizations were nominated as opportunist and unwilling to collaborate openly and fairly: 'certain individuals from other academic institutions [forgot] that the first "C" stands for cooperative'; and 'some institutions are NOT "cooperative",' said several academic respondents.

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. Academics and government respondents suggested that 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', said one. Reneging on commitments was viewed seriously: 'ensuring in-kind contributions match commitments'; 'multi-partner programs are unwieldy when [the] percentage commitment of individual staff is low (<30%) and over-ridden by host institution priorities' were raised as problems. 'Inflexible and one-sided IP arrangements' were also viewed with distrust as a form of self-interest.

The factors contributing to the maintenance of trust *between partners* appeared similar to other IORs, but judgments of trustworthiness were made more difficult by the inherently unmeasurable nature of R&D outcomes and difficulty of assessing the actual level of resources (particularly 'in-kind' staff time) actually being committed by the partners. The actions that seemed to be regarded as most trustworthy were: being able to carry out quality research, exchanging information and knowledge, executing agreed tasks and generally being accommodating to and cooperative with other partners.

The challenge to both individual and institutional participants in the centres was to 'make stronger efforts together to achieve the main aim' and acknowledge 'each other's needs and goals', in the view of one CRC employee; or simply, 'to learn how to cooperate rather than compete' by a university-based respondent. In the following section, we consider what implications these views have for the governance of CRCs.

3.2.2 Perceptions of governance

The role of governance is to unite the CRC around agreed strategies and to reconcile various goals. There is also formal obligation to report to the partners and the funding agency on research projects and outcomes. Surprisingly, respondents were quite ambiguous about the governance of the centres and regarded these activities as unnecessary costs. Many found administration frustrating, cumbersome and burdensome. 'Transaction costs are very high' and 'there is a large administrative cost linking different institutions'; 'dual reporting needs', were typical responses when asked about problems with the management of the CRC. Transaction costs were viewed as more onerous than with alternative forms of research support: 'compared to an [Australian Research Council] 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' commented a senior academic. Respondents found the CRCs cumbersome and unresponsive in more commercially-oriented activities too: 'slow processes with regards to commercialisation, licensing and marketing' charged one information technology academic.

Respondents commonly criticised the centres' (and the program's) governance activities because of their detrimental effect on research. The management burden distracted them from their main concern of carrying out research: a 'massive percentage of funds spent on administration rather than research'; and, 'the CRC reporting requirements strongly impinge upon research time and activities' were typical claims. Another academic was annoyed about 'arbitrary decisions to reduce committed [research] funding to enable "communication"'.

A further point of contention was the 'politicking' and power relations within the centres. As one senior academic succinctly put it: 'if you can capture the centre, you are provided for; if not you are marginalised'. 'Autocratic leadership; high staff turnover; lack of communications; lack of transparency on employment of researchers' were some of the specific problems listed. 'This is not a collaborative organization…internal politics rather than rational assessment of priorities determines resource allocation'; and administration

seemed 'pointless', with 'no management feedback even to project leaders' claimed two academic respondents.

Some respondents felt ignored: 'I do not have much say in the affairs of CRC. I know I have the capacity to contribute more but no takers'. Others felt controlled: 'we get told what to do', or even coerced: 'many of us were put in the [nominated] CRC by senior [university] management without any discussion in order to meet…targets shown in the proposal. Most of us were not even aware of the proposal, nor asked if we wished to be involved… Attempts to be removed from the [nominated] CRC were met with threats of dismissal'.

Two main findings emerge. The first is the 'coordination burden' or increased transaction costs of complex cross-sectoral, multi-organizational collaboration. Respondents expected their 'CRC experience' to be about research, *not* about administration. This was particularly felt when feedback and communication were lacking. The second is the expectation of collegiality and cooperation in the governance of the centres. The respondents demanded a strong say in the strategy and running of the CRC and were unhappy when they were not consulted and engaged.

Negotiating a CRC 'identity' is revealed as very much a collective process. But it is not simply generating a coalition of interests from participating partner organizations. It is a social process of defining boundaries: who we are; what we do; what is acceptable and what is not; who is in and who is out. It is these very individual definitions as much as any organizational expectation that drives centre identity building.

3.3 Resolving conflicting demands

To the extent that individual expectations are part of the 'centre building' process there are likely to be conflicts of interests or divided loyalties, particularly among those on part-time secondment to CRCs. As noted, researchers generally commit only part-time to the CRC and remain based in their 'home' organization—their university or government laboratory. This led to respondents' experiencing the symptoms of 'role strain', identifying overload and 'divided loyalties as an issue, particularly with long running CRCs'. Having two masters made it harder to work within the CRC framework than on projects which were less complex in structure, as one government researcher observed:

> It is a constant challenge to meet the multi-layered management requirements of both [the home organization] and the CRC. There is potential for both conflict and administrative overload, which makes CRC participation significantly harder work (albeit rewarding) than simply working 100% on [the home organization] projects.

Another government-based respondent interpreted this as losing control of the project:

> …organizational commitment to allowing time (that is, having time left over from other organizational duties to dedicate to CRC projects) which means much of the running of the projects is necessarily left to university researchers.

'Interaction with parent institution' and 'an inherent problem of split loyalty between the employer and the CRC' were identified as problems by a large number of respondents: '[it is] difficult to know who is the master, the CRC or [the partner]'. A senior manager employed in a CRC, saw it more starkly: 'their host organization always dominates the researcher priority as that is who promotes and pays them'.

Several sources of conflict were identified. The first was competition for resources—primarily researchers' time between the work of the CRC and the work of the parent

organization. Researchers felt pulled between their 'regular job' and their commitment to the CRC: 'meeting deadlines due to 'normal' core commitments'; and 'too much of my time spent in managing researchers and contracts for the CRC'. But rather than seeing the issue simply as one of individual choice, they criticised their organization. One academic complained that 'my university/school has not honoured my in-kind contribution to the CRC'. A government researcher similarly observed 'I was a program leader in the CRC. I don't think I was properly supported in the role by my own organization'. Researchers had chosen to work with the CRC and expected their employer organization to support them and to manage any conflicts. When the organization did not, this competition for resources could affect researchers who were not affiliated with the CRC, and give rise to competition *within* the partner organization, as in the case of this university:

> The CRC research and time commitments done by faculty in our school who have contract agreements is being subsidised by other faculty. This is because no [money] was given to the school to cover the teaching and administrative responsibilities of these faculty members. It has led to a major rift within our school and has severely impacted the ability of non-CRC committed faculty to engage in research.

The second conflict was between the ways that CRC acted and the practices and norms of the partner organizations. A senior manager in government characterised this as a 'clash in management ethos between [the CRC's] CEO and the practice of the participating organization', while a CRC manager commented on the participants 'interfering with management structures of other parties'. This was found in communication, timing of activities, accepted protocols for supervision of research students and so on: the 'CRC attempts to control [postgraduate] students with no regard to supervisors', claimed a senior academic; while a senior government researcher countered:

> [The] main work force in CRC [is] derived from PhD students. This leads to a conflict between research and commercial priorities. Students need to do work to complete their PhDs whereas industry is focused on producing products.

Another academic respondent welcomed 'funding for students' as a benefit, but noted that 'regrettably [the funding] does not go through university channels' and thus did not earn matching funds from university block grants for research.

A particular conflict was identified between the work of the CRC and the reward structures of the partner organization. This could have a direct and immediate effect on the career of the researcher if the researcher's service was not recognised by the partner organization:

> When my contract with [nominated agency] expired…I had worked for the organization [for more than seven years]. However, I was advised I was ineligible for 'indefinite' appointment because I had been a CRC associate employee for most of this time! So no, I got no benefit from being a CRC employee with [nominated agency].

In many cases, as an early-career researcher employed by a CRC observed, 'researchers in CRC do not have [a] clear career path'. Often, the impact was more subtle. 'The research success of an employee in a CRC project may not necessarily be properly acknowledged by the employer' said a semi-retired respondent. Another, seconded to a CRC at a senior level, found a 'complete disjoint between performance appraisal by my employer and my actual work in CRC'.

Conversely, the requirements of the CRC might prevent or stifle peer recognition of the researcher, either by their employer, or in their wider scientific peer group. Two areas specifically identified were: (1) constraints on free publication and (2) access to prestigious research grants from bodies such as the Australian Research Council (ARC). Several academic respondents nominated 'publication restrictions' and 'delays in publishing while CRC makes decisions about IP protection'. Another academic who had experienced publication delays lamented, 'the short-term objectives of the CRC are destructive for an academic career'.

'Ineligibility for ARC funding' in particular was hard felt by academics. It potentially hampered recruitment to the CRC and collaboration with researchers outside the CRC, as a senior government researcher noted:

> Academics on ARC funding [are] very unwilling to collaborate lest ARC and CRC support is seen to mix—a number of very exciting and important collaboration opportunities [were] lost as ARC funded researchers were unwilling to 'risk' their ARC support by taking benefit from CRC projects.

Because CRCs bring together research and commercial interests, it is not surprising that a further field of competition within the CRC can be a philosophical clash between the rationale of CRC and its industry partners and the norms of 'science'. This may not adversely affect immediate rewards, but some researchers clearly felt uncomfortable about the direction of the CRC and the balance of its activities. Comments by academics on particular CRCs included: 'too much emphasis on commercial outcomes and not enough emphasis on research'; 'lack of scientific vision —short-term objectives prioritised'; 'suppression of truly innovative basic research'. Conversely, a senior government researcher charged that 'some academic researchers [are] biased against 'applied' CRC research'. Criticism was also made of the program as whole: 'if the Science is left out in favour of commercialisation issues I believe the image and product of the CRCs will suffer considerably' said an environmental scientist working for government agency.

Some participants reacted personally to these problems. One ex-industry researcher suggested that 'evasion' takes place:

> The CRCs message as conveyed by the CEO, the Executive Research Committee and the relevant program coordinator has been effectively ignored by project leaders (who have been protected by their institution's management).

'Exit' is an option too. Several respondents reported that they were quitting. An early-career academic commented, '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'. Others had 'decided not to participate in other CRCs', or, more forcefully, 'it has clarified my directions—I never want to work with one again'. At the organizational level, selective exit was considered: 'Some projects were withdrawn from the CRC so that a higher level of external investment and low level of encumbrance could be achieved' revealed a senior government manager.

In highlighting these different aspects of competition we argue that they reveal different 'functional domains' that co-exist within the centre and across the partner organizations. Individual participants' expectations are formative in defining these domains—for example, adherence to the norms of science, or expectation of advancement in an academic career—but their management and interrelationships are matters for the organizational partners. Without effective institutional management, individual participants have little redress but withdrawal.

4 Conclusions

The paper distils the views of more than 200 participants in a particular form of cross-sector research centre in Australia derived from a single mixed-mode (postal and web-based) survey. The comments reported here are from a subset of 370 academic and government-based researchers who responded to the survey. The broader survey achieved a satisfactory response rate of 34% and covered more than half of the extant centres. One aim of the project was to investigate the effect of participation in the centres on researchers in academia and the public sector. Industry partners were excluded from the scope of the project.

We conclude that the working environment and sustainability of such centres cannot be understood by looking solely at the individual choices of researchers, nor solely at the strategies of the partner organizations. Both are formative. In highlighting important management issues which have been recognised generally within IORs and illuminating these with the views of the CRC participants we aim to improve the management of the dynamic organizations that are collaborative R&D centres. The IOR perspective is useful in emphasising the role of trust in loosely collaborative relationships, the ambiguity of formal governance, and the co-existence of organizational 'functional domains' which have the potential to compete or conflict. These are issues that have not been ignored in relation to cross-sector R&D, but have perhaps been under-researched.

Our respondents tended to see the benefits of the CRC first in terms of advantage to their own research career and second in terms of the 'scientific' domain in which their career resided. Their most immediate concern seemed to be that of their own career—how they were able to perform their research, their conditions and rewards—their prospects for advancement. They regarded as a cost or a burden anything (administration, reporting, short-termism, constraints on publication) that diverted them from their research career. At the same time, the presence of commercial partners and the government's goals for the CRC program, which imposed a commercial imperative on the collaboration, was not unwelcome in itself. In this sense our findings are unremarkable: the respondents' expectations are not that different from those found in other research groups 'at the interface of, university research' (Harvey et al. 2002). What our findings do show is that CRC researchers frame their identity primarily in terms of a culture of open science, built on the quality and validity of research performed, which is ensured through public sharing of knowledge (Liebeskind and Oliver 1998; Ziman 1991).

The second conclusion we draw is in relation to the importance of informal 'trust' by comparison with formal governance of the centres. Respondents were quite clear in the importance they attached to their research partners' competence and commitment. However, they were far more ambiguous about the governance and coordination activities of the centres. There are two ways of looking at how cooperation can be ensured: (1) a social theory approach—reciprocity, mutual forbearance, relational trust (based on experience); and (2) using transaction cost economics—with the concept of opportunism (not acting cooperatively), and monitoring of performance, sanctions (legal punishment, penalties and so on; Menard 2004; Handy 1995; Nooteboom 2000). While the level of administration and reporting in the CRCs might imply the latter approach, in reality, any form of imposed sanction was viewed by respondents most unfavourably. Thus, although the collaboration between the partner organizations is contractual (because they are legal entities), its implementation and enforcement at the level of the department and individual researcher appears to be informal. This raises the question of effective coordination in a multi-institutional environment, where the partners and individual researchers essentially remain free agents, despite contractual commitments.

Respondents were clearly expecting reciprocity in the degree of commitment and expertise, provision of resources and information, forbearance of different ways of working and an absence of opportunism. Any evidence of a breach caused respondents to become less enthusiastic about the centre, and sometimes to quit the CRC. Monitoring of performance might have helped to identify breaches, but there were few sanctions that could be applied on one partner by another. The only sanction therefore was to withdraw, or threaten to withdraw, from current or future collaboration, thus breaking the durability of the relationship.

The findings support the need to consider closely the 'costs of coordination and relationship development in these collaborations' (Cummings and Kiesler 2005: 704). But in contrast to Cummings and Kiesler's claim that greater trust and respect is associated with more frequent communication, respondents in our survey did not universally applaud effort on formal 'communication activities'. Further research is clearly warranted on how formal activities within the centres can buttress rather than undermine construction of trust between the partners in different settings.

Lastly, our findings suggest the existence of a range of tensions and competing demands within cross-sector R&D arrangements which go beyond the notion of individual 'role strain'. Certainly individual scientists may become torn between the objectives of their own academic 'identity', the norms and requirements of their university department and scientific discipline and the mission of the CRC. Our survey shows that many of the participants expect the centres to be collegial rather than strongly hierarchical in their management structures. In the language of Hofstede's cultural dimensions they do not accept a 'high power distance' and expect to be allowed to behave in an 'individualistic' rather than in a collectivist manner (Hofstede and Hofstede 2005). When centres become overly 'top down' in their planning and government this is seen as impinging on researchers' scientific creativity. These tensions imply an institutional as well as an individual response. For example, if we consider the management problem of 'threat of exit' we need to recognise that this 'threat point' can occur at different levels. It is possible for a researcher (academic level) to decide to or threaten to withdraw from CRC participation, even though continued participation may be to the benefit of their discipline (scientific) or laboratory/university (organizational).

Managing an organization like a CRC requires recognition of the needs of these different functional domains and relationships, as well as an understanding of the competition that they provoke. This includes the potential for conflict internally over governance and strategy and between the CRCs and the norms and practices of the contributing partners. Intangible benefits and their implications for individuals' careers are important factors that motivate researchers to participate in CRCs. Organizational partners are usually seeking more tangible outcomes although they too are also motivated by the potential for enhanced scientific prestige. As centres endure some of these expectations are met and some are not. Individuals and organizational partners will continue to negotiate the costs and benefits of meeting their expectations. As the process unfolds for individuals and organizational partners some will come and some will go. Consequently it is likely that while there are conflicts of interest to be resolved the centre identities will continue to be renegotiated.

The Australian CRCs embody many features of 'Mode 2' collaborative science, with its flexibility and ability to respond to contextual changes in science itself and in the application of science. Indeed it may be counterproductive for individual CRCs to become entrenched. However, if the important role 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' domains that we describe must be nurtured, not eroded. This may require new styles of management, by the CRCs themselves and their participant

organizations, which recognise the knowledge resources—the scientific disciplines and careers of individual researchers on which they are founded.

4.1 Broader implications

The current study suggests two further lines of investigation. The first is the effect of scales and forms of organization on cross-sector R&D outcomes while the second is in relation to the dynamics and sustainability of cooperative centres.

Scale and forms of organization constrain the management issues. The findings from Australia may not apply generally to other centres. For example, in European studies (Jacob 2000: 25) the question of 'is Mode 2 research worth it from the individual researcher's point of view?' is couched in terms of disadvantaged 'contract' researchers (in the centres) on the one hand, in contrast to well-resourced 'tenured' academics (in traditional university departments) on the other. The Australian situation is more akin to the US model described by Boardman and Bozeman (2007) where researchers face competing demands. In the CRCs the majority of academic researchers retain their existing university position and agree to commit a proportion of their time to the collaboration. Similarly, government researchers are not seconded to the CRC but remain employed by their partner organization. Relatively few researchers (with the exception notably of postdoctoral fellows) are employed by the CRC itself. In this regard CRCs are unlike the centres alluded to by Jacob where staff are employed directly on full time but short term contracts.

The study also raises the question of how durable the cross-sector R&D organizations are and how their management can change over time. On one hand, this form of organization is becoming more dominant. On the other, the collaborations need to remain flexible and responsive with 'ceaseless reconfiguration of resources, knowledge and skills' (Gibbons et al. 1994: 47). CRCs are not 'cooperatives' in the sense of being member-based, democratically controlled organizations. But they may start this way, recruiting voluntary participants in the bid for grant funding. In terms of Handy's four organizational 'cultures' (power/role/task/person) they start as a 'person culture' and move into a 'task culture' once goals are agreed and funding achieved. This sequences implies a balance between cooperation and cohesion (which, to some extent, implies control), a view endorsed by Chompalov et al. (2002: 752) who 'suggest that collaborations be viewed in terms of the principle that "consensus precedes hierarchy"'. CRCs start as cooperative bids, but must develop more cohesion and coordination to be effective. The problems, as Nooteboom (2000) observes, is that if networks are too cohesive they may become exclusionary, and if too durable they create inertia. They may be very effective for particular well defined tasks, but in the process they lose flexibility and ability to change. At the extremes, two scenarios may play out in the life cycle of a CRC. First, is 'disintegration', where the ground rules are either too weak or not accepted or adhered to by all partners and individual participants. The second is 'integration', where the rules are so effective that they stifle change—perhaps for good reason, such as a focus on commercial production—and the structures become more autocratic or hierarchical. We conjecture that CRCs that form as a stimulating cooperative research environment may change into a setting that some researchers find unproductive or frustrating to their science or their careers. Individuals then have the option leaving the collaboration by retreating to their 'parent' organization if the strain becomes too great. We did not make a long term study of particular CRCs in the current paper and suggest that this proposition needs testing through longitudinal studies of cross-sector R&D organizations and their participants.

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