Managing the risks of R&D collaboration in the Australian Cooperative Research Centre program

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Abstract
The paper presents initial findings from a study of cross-sector commercially-focused R&D collaborations in the Australian Cooperative Research Centre (CRC) Program. The study focuses on how effective collaborative relationships are built between organizations with divergent interests and cultures and different approaches to commercialization. Findings are reported from the first case study interviews. Analysis of the transcribed interviews has produced 16 themes on the management of CRC collaborations. The theme on the management of intellectual property (IP) is discussed. IP management represents a major source of risk to collaborations, and the issues identified reveal much about the trust dynamics involved.

Introduction

In this paper we present some initial findings from an ARC-funded research project which seeks to contribute to theory on interorganizational collaboration (IOC) through an empirical study of one contemporary example of cross-sector R&D collaboration, the Australian Cooperative Research Centre (CRC) Program. The study aims to complement the large and growing literature on IOC and to extend existing research on cross-sector collaboration (to date, largely focused on government and voluntary sector collaborations and "public/private partnerships") to include initiatives which are focused on market outcomes resulting from collaborative R&D. This latter form of IOC is unique and involves cross-sector collaborations established under the auspices of government-sponsored "hybrid agencies" - like the CRCs - to conduct R&D. Such collaborations, which involve consortia comprising public sector research agencies (e.g. CSIRO), universities and companies, bring together stakeholders with quite different interests, objectives, modes of operation, capabilities, resources, timeframes and commitments. What is of particular interest in these collaborations is that, although they are not market-based (i.e. not established on the basis of market transactions), and they involve "public sector" organizations which are not generally driven by market considerations (i.e. are not primarily in the business of commodity exchange), they are set up to develop marketable products or other commercializable technologies. Our research focus is unique in that, while the more general topic of university-industry research partnerships has been the focus of a number of recent studies in Australia (e.g. Rappert, Webster and Charles, 1999; Harman, 2001), very little detailed research has yet been conducted to examine how the CRCs operate (among the few published studies on the CRC Program to date are Turpin, 1997, and Liyanage and Mitchell, 1994a, b), and none have specifically investigated the dynamics of commercially-focused collaborations.

Over the past few decades cooperative interorganizational forms (such as strategic alliances, networks, joint ventures, and consortia) have proliferated, and there has been a concomitant growth in academic interest in this phenomenon (e.g. see Powell, 1990; Powell, Koput, and Smith-Doerr, 1996). However, the burgeoning academic IOC literature is diverse, fragmented and often confusing. We have noted at least three main problems with this field of research. Firstly, taking a working definition of interorganizational collaboration as: a voluntarily-initiated cooperative relationship between two or more organizations which is not, or not purely, based on market transactions and which involves *"reciprocal, preferential, mutually supportive actions"* (Powell, 1990: 303), the range of different types of interorganizational collaboration is very large. Clearly, IOC is a very heterogeneous phenomenon, and encompasses a plethora of arrangements which can involve collaboration across economic sectors and industries, and which can vary by geographical scope, number of collaborators, formal status, nature of cooperation, purpose of cooperation and time span. A second problem is that

academic accounts of the phenomenon use a confusing diversity of terms, often interchangeably. Such terms as "alliance", "network", and "joint venture" are frequently used but with varying degrees of specificity and even equivalence of meaning. Thirdly, the phenomenon has been studied from a number of disciplinary perspectives (e.g. economics, organizational studies, management, marketing) and has drawn on a variety of distinctive theoretical approaches (e.g. transaction cost economics, game theory, social network theory, social modelling theory, institutional theory, and resource dependency theory). The problem here is that, as Gray (1999: 3) has noted, there is no widely-accepted and overarching theoretical framework to help explain the emergence and dynamics of interorganizational collaboration; worse, the cacophony of approaches has led to fragmentation and even conflicts of interpretation. Our study seeks to navigate through this Babel and, by focusing on a specific empirical manifestation of the IOC phenomenon, help to make sense of this increasingly prevalent but diverse phenomenon.

The empirical focus of our study, the CRC Program, was launched by the Australian Government in May 1990. The Program was created specifically to encourage cooperation between researchers and research users across public and private sectors, thereby strengthening the link between research and its application. There are currently 64 CRCs (more than 80 have been created over the life of the Program) and the Government funding for the Program in the 2000 fiscal year was around $140 million (3.5% of the Commonwealth's financial support for science and innovation). In 2001, the Government announced in its Innovation Statement "Backing Australia's Ability" that the CRC Program would receive an additional $227 million over five years so that it could expand (i.e. by increasing the number of CRCs, enhancing the opportunities for SMEs to participate in the program, and increasing international collaboration under the program). The CRC initiative has been part of a broader policy shift which has emphasized making public-funded research (and most notably university research) "more relevant" to national needs and which has sought to gain greater business support for public sector research. Following a joint ministerial review in 1998 there has been a greater emphasis on commercialization in the Program with more of a *"focus on novel technologies that can assist Australian industry to become more innovative, competitive and productive"* (CRC Compendium 1998: iv). This emphasis on enhancing "the use and uptake of research" has been reinforced by more recent policy developments in tertiary education (e.g. the Government's 1999 White Paper "Knowledge and Innovation – A Policy Statement on Research and Research Training"). The policy shift towards reducing purely government-funded research in universities, and on improving cross-sector collaborative linkages, is a worldwide trend and the CRC Program one of its manifestations (Turpin, 1997).

The paper is developed in the following way. We first discuss our theoretical considerations, focusing on the constructs of trust and risk. Secondly, we outline the research methods through which we have begun to collect data on the management of collaboration within the CRC Program. Thirdly, we present some preliminary findings from an analysis of the qualitative data we have collected so far. We conclude by noting the significance of our findings and by indicating the future direction of the ongoing research.

Theoretical Considerations

Our starting point is to note that, with cross-sector collaborative R&D, there are a number of problematic issues that need to be addressed by the partners for the collaboration to succeed. Firstly, as emphasized in transaction cost economics (e.g. Williamson, 1985), there is the potential problem of opportunism that can arise from the relationships of dependence among the partners. This can include violations of trust, breaches of confidentiality, the misappropriation of proprietary knowledge, and other forms of opportunistic behaviour whereby one of the partners exploits the collaboration to its own advantage and at the expense of the other partners. Secondly, and a major incentive for organizations to work together, there is the uncertainty, cost and risk associated with R&D. It can never be known at the outset whether a particular line of research will result in desired outcomes, developing commercializable new products is costly, especially where it involves technological breakthroughs (e.g. due to the high costs of development itself, of protecting and managing the intellectual property created, and of meeting regulatory requirements), and in a competitive

environment with a number of players conducting R&D in the same area there is always the possibility of either being pre-empted or having a technological development made obsolescent by a competitor. Furthermore, R&D often involves long timeframes, longer than usual business cycles, which increases both risks and costs. Thirdly, such collaboration involves a "clash of cultures" whereby disparate organizations (public sector versus business organizations) with their distinctive practitioner cultures (e.g. scientists, clinicians, and product development engineers) seek to work together to pursue a common goal. Cross-sector R&D collaboration involves the building of effective working relationships between organizations with divergent interests and objectives, operational timeframes, resources, and levels of commitment to commercial outcomes. So, a key question here is: how are these problematic issues addressed by the partners and a "community of interest" (Kastrinos, 1996) built?

Two constructs that have been widely invoked in the IOC literature, trust and risk, would seem to be pivotal here. The concept of trust has had a long history in collaboration studies (e.g. Ring and Van de Ven, 1992, 1994; Ring, 1997; Gray, 1999). It is now generally agreed that trust is an essential prerequisite for IOC, especially for those collaborations which involve high levels of uncertainty about outcomes, as is the case in R&D projects (e.g. Häusler, Hohn and Lütz, 1994; Browning, Beyer and Shetler , 1995; Lütz, 1997). Cross-sector R&D collaboration also exposes the collaborating partners to considerable risk (i.e. the possibility that some negative outcome will occur, that things may go wrong or not as planned, and that as a result some cost or penalty is incurred by one or more partners), and this has also been investigated in some IOC studies, notably from the perspective of transaction cost economics (e.g. Nooteboom, Berger and Noorderhaven, 1997; Nooteboom, 1999). However, although the "risky" nature of IOC is widely acknowledged (especially given that many such collaborations involve power asymmetries; see, for example, Powell, 1990: 318), the concept of risk in this context remains poorly theorized. Yet risk management, notably the conceptualisation and evaluation of perceived risks by managers as a basis for action, is a key element in the formation and ongoing management of such collaboration. Further, as Nooteboom (1999: 25) points out, *"trust ... carries the risk of betrayal"* and trust can be related closely to the notion of risk *"... in the sense of the possibility that things can go wrong"*. Risks arise in collaborations from a number of sources, and include relational risks (which arise from the opportunistic behaviour of partners pursuing their own self-interest), the risk of spillover (through collaborative linkages a company's strategic knowledge and core competencies may be leaked to competitors), and risks associated with the uncertainty of R&D projects and the competencies of partners. A key focus of our research is on understanding how the risks in cross-sector R&D collaboration are identified and managed by the collaborating parties, individually and collectively (Couchman and Fulop, 2001a, b).

Research Methods

The main aims of the research are to: (a) investigate the role of the CRCs as a medium for facilitating cross-sector R&D collaboration in Australia, and (b) identify the factors which contribute to sustainable cross-sector linkages in CRC programs, with a particular focus on the nature of relational and competency-based risks in commercially-focused R&D collaborations. In pursuing these aims, the case study method was chosen as most appropriate and feasible. It is also planned to complement the CRC cases with two longitudinal studies of collaborative projects using a processual approach to investigate how such collaborations are developed and managed (Prabhu, 1999). Given our focus on those CRC activities concerned with the development of commercializable new technologies, four CRCs with a high commercial orientation have been selected as case studies (i.e. from among those which fall within Category 1 "Commercially Focused with Specific Users" identified in the Mercer-Stocker Review, 1998). To ensure that industry-specific factors relevant to cross-sector collaboration are identified, the CRCs were selected from two industry sectors (Manufacturing Technology, and Medical Science and Technology).

For each case study, data is being collected through semi-structured in-depth interviews with CRC managers, board members and research leaders. The open-ended questions in our interview schedule were derived from a review of the IOC literature and from preliminary discussions with key people involved with the CRC Program. The interview data is being supplemented with secondary data

sources such as CRC Annual Reports, public-domain documents on the CRC Program, published research papers, and administrative records of CRC projects. Analysis of this secondary data enables us to contextualise the primary data, to complement and verify interviewee accounts, and to obtain background information about board structures, legal contracts, management practices and research programs. All interviews are tape-recorded and then transcribed. The transcribed interviews are imported into the qualitative data analysis software "NVIVO" which is being used to develop analytical accounts, and notably to identify general patterns across the cases, through a categorization and theme analysis of the interviewee responses (e.g. Strauss and Corbin, 1998). The findings reported below are based on such an analysis of the first set of interviews conducted with managers from two of the CRCs.

Managing Collaboration In The Crc Program: Initial Findings

The CRC Program in a Changing Context

While companies are relying more and more on various forms of IOC in the conduct of R&D (in order to share risks, obtain access to new markets and technologies, reduce time-to-market lead time for new products, and to access complementary skills and knowledge), there is evidence to indicate that this collaboration increasingly involves public sector organizations (e.g. Narin, Hamilton and Olivastro, 1997; Okubo and Sjöberg, 2000; McMillan, Narin and Deeds, 2000). As a result of this trend, the organizational pattern of R&D activities within and across national economies has changed markedly (Etzkowitz and Leydesdorff, 1997). In Australian universities, there has been a dramatic rise in the number of research centres which draw their research budgets from a wide range of funding sources, both public and private, external to their host institutions. This growth in research centres, as exemplified by the government-funded CRC Program, represents a major medium through which university research has become more linked to industry (Turpin, 1997).

Clearly much has changed in Australia's political economy since the CRC Program was established. There have been major changes in industry, the policy milieu and the education sector since 1990, changes which have been fuelled by increasing competition in a globalising economy and technological change (notably in information and communication technologies). Set against this changing environment there have been seven selection rounds for new and renewing CRCs, and there has been considerable learning about the program among the various players. This learning can be illustrated by comments made by participants in an open forum at a Brisbane CRC conference in May 2000. A content analysis of the recorded responses to general questions about cooperation in the CRC environment reveals some interesting understandings of the dynamics of cross-sector collaboration within the CRCs. Firstly, the comments reveal an explicit recognition of the particular advantages of the CRC framework. Four themes can be identified here, as shown in Table 1 below.

Table 1 About Here

Secondly, there was a recognition among the conference participants of the essential prerequisites for collaboration to succeed. As organizational theory would indicate, there was an awareness of the need to build trust and effective relationships among the participants in a CRC and especially with the industry partners (e.g. *"Vital to establish and maintain trust among the players", "Foster trust and understanding", "Need to work on trust and relationships within the broader organization", "Industrial relationships determine success", "Very close relationship between researcher and commercializer, the closer the better"*). But while the need for cooperation, and a willingness for partners to collaborate, was acknowledged by some of the commentators (one went so far as to claim that the CRC program was *"changing the mindset from competition to cooperation"*), there was a degree of ambivalence in the forum. On the one hand it was recognised that *"cooperation is to do good"* and *"cooperation offers different opportunities for doing business"*, but on the other hand it was observed that *"cooperation means different things to different sectors"*. Furthermore, there was a questioning of the universal acceptance of the benefits of cooperation (e.g. *"The assumption is that cooperation is the best way to achieve desired outcomes – this may not always be so", "CRCs can't work without cooperation, but some conflict is part of a healthy competitive environment and can add to momentum", "The benefits of cooperation for organizations do not work"*).

Clearly, interorganizational cooperation is a difficult phenomenon to manage and there is a marked tension between cooperation and competition within and across the sectors. This leads to a third theme that the analysis of the comments revealed: there are a number of conflicts or tensions that need to be addressed within the CRCs for successful collaboration to be achieved. It is recognised that there are conflicts of interest among the players in a CRC, indeed often so between a CRC itself and its participants, and this may be manifest at the board level or in the management team. These conflicts are associated with divided loyalties among those working on CRC projects, a problem that could be exacerbated by competition and a lack of cooperation among individual researchers and research groups. Commercialization, and the management issues associated with intellectual property ownership were also putting pressure on collaboration. Differences in the nature of the organizations across the sectors – e.g. their cultures, organizational structures and management systems – also created tensions. As one commentator put it: *"Institutional barriers are not conducive to collaboration or synergy"*. Foremost among the suggestions for improving cooperation within the CRCs were recommendations about rewards and HRM strategies to address the identified tensions. In the former area it was argued that the rewards of collaboration should be more equitably distributed to provide greater incentives for all partners (e.g. *"Develop equity and consistency in rewards – incentives and recognition", "Reward the achievements equitably and recognise the importance of spill over benefits"*). Suggested HRM strategies included a need for specific training (e.g. *"Management training for program project leaders", "Leadership training for boards, chairs, CEOs, etc. in collaborative management", "…. Focus on training in leadership, communication and relationship management", "It is important to train CRC personnel, particularly management training"*), and for team-building activities (e.g. *"Early in the life of a CRC there must be bonding, eg through a retreat for all …", "CRC team-building retreats should be annual events", "Prepare people to work in cross-organizational team situations", "More use of CRC retreats and frequent get-togethers at all levels … for team-building …"*).

The themes raised in discussion at the Brisbane CRC conference provide a validation of our research focus. Thus, the questions we seek to answer are: how are the essential prerequisites for effective collaboration addressed by the participants in a CRC and how are the inevitable tensions among the partners managed? These are questions that we are exploring in our interviews with CRC managers.

Intellectual Property as a Source of Risk in the CRCs

The following findings were derived from an analysis of our initial set of interviews, covering two of the CRCs in our sample, as noted above. Sixteen distinctive themes were identified during the coding of the interview transcripts. The themes so identified could be grouped into two broad categories: CRC management structures and processes (e.g. facilitation, funding, relationships, risk, etc.) and collaboration outcomes (e.g. intellectual property, spin-offs and commercialization, technology transfer, the market, etc.). Due to the space constraints of this forum, we will only discuss our initial findings on one of these themes, intellectual property (IP). IP is of particular interest because it represents a major source of risk to the formation and management of cross-sector collaborations, and indeed the viability of R&D projects which seek a commercializable outcome. The negotiation and bargaining around the management of IP in a project or program goes right to the heart of the processes through which collaborations are conceived and developed, revealing much about the trust dynamics in the building of cooperative relationships. The management of IP is therefore pivotal to all of the other themes identified in our interviews.

In one of the few academic studies on the CRC Program, published when the Program was in its infancy, Liyanage and Mitchell (1994b: 2) noted that: *"The ownership and exploitation rights to intellectual property are major factors that determine the viability of cooperative research relationships. … The issue of intellectual property rights has emerged as a major area of concern for all partners involved in collaborative research."* The issue of IP arising from a cross-sector collaboration is a particularly difficult one because there is a fundamental conflict on this between the partners (Rappert et al., 1999). Companies generally want to protect their own know-how and any new IP in which they invest. They therefore seek exclusive access to the IP arising from a

collaboration, and will enter into legal agreements to ensure this. As part of the collaborative regime they will require that researchers maintain secrecy and not publish anything that would result in a leakage of proprietary knowledge or the premature release of potentially-valuable IP. This position conflicts with that of universities which seek a recognition for their knowledge base. Publication in refereed public domain journals is central here, and it remains the basis for the appointment and promotion of academics. Academics who participate in CRC projects with commercializable outcomes run the risk of decreasing their career development prospects. Our interviews confirm that the management of IP remains a major area of concern for all parties involved in the CRCs.

Those CRCs with a commercialization focus devote considerable energy to the management of IP. They do this through the contractual agreements under which the centres are established and partners agree to collaborate *("I guess we are protected by a centre agreement which basically says that any IP developed by the centre is the centre's unless otherwise agreed to", "[industry partners] don't have automatic rights to the IP; the rights to the IP have to be negotiated with us"*), and through specific project agreements *("Even prior to the development ... we have a licensing agreement up-front as part of the project agreement"*). Where IP is critical to a project, the CRCs also ensure that confidentiality is maintained through staff education and training (*".... by very carefully going over the issues of confidentiality with all staff", "I just did my IP seminar with the staff about three weeks ago, another one because we were concerned about conference presentations"*), by putting in place procedures for controlling publication by researchers (*"We basically have a review process which includes looking at anything that's getting published from the point of view of IP ... and that means sometimes that you can't publish .. but we make that clear up front"*), and by generally seeking to create a culture where secrecy becomes the accepted way of doing things *("People are very aware of not giving away secrets", "... making people value keeping secrets"*). But despite such systems and procedures, the management of IP remains problematic *("The tension points are ownership of IP and the interpretation of the CRC agreement", "I'm spending more time than I'd like to on patenting and the commercialisation agreement where IP is probably ... the hardest part ...", "We've had problems and disputes over ownership of IP with [the CRC]"*). The formulation of an agreement acceptable to all parties can be difficult, especially where one or more of parties have a different interpretation over what is or can be covered *("...the agreement would have been settled in no time at all, but you know they will take it to the point where they say that the knowledge walking around in people's heads [should be covered] ..they can make claim on everything they are involved in from that point of view ..."*). Furthermore, the negotiation of an agreement can inhibit the initiation of a collaborative project *("... if I think the opportunity is right, you've got to grab it when you've got some industry partner going 'we'd really like this to happen'. I also recognise that you've got to by-pass [IP agreement procedures] sometimes when you've got to get something going, particularly with someone new that you can bring in and you can show that you're responsive. As soon as you say we can't start this because we have to have an IP agreement in place, I know exactly what the reaction is, you know, 'God here we go again'."*).

Despite attempts to clarify the situation for researchers, and emphasising the benefits of controlling IP *("People have got to realise that there is a value in having patents and things of that nature"*), publication remains a contentious issue for academic researchers involved in CRCs *("Some of the people working on [a project] were great publish or perish people ... they wanted to publish, and the worst thing was they were saying 'look we're going to have to stop', and the debate raged and I had to think of the industry partner here ...", "... when you are writing a paper you actually make discoveries ... then you say 'oh, this is pretty good', [but] you can't publish it, they won't like that at all and it's another cultural thing where people have got to get used to it"*). This is a difficult issue to manage and a source of tension between researchers and industry partners (as one manager from an industry partner put it: *".... some people within [the CRC], you know, would think it's their right to be able to publish anything they work on, and that's not acceptable to us basically"*). This leads to a related issue, that of concerns about knowledge leakage. This was raised a number of times in the interviews with industry partners. Industry partners are interested in gaining control of the IP and thereby obtaining the exclusive right to its use *(" .... We're not after ownership, we're after control. I mean it's nice to have ownership but that's not the critical thing. The critical thing is to be able to*

have an exclusive right to use."). Associated with this is the need to maintain confidentiality about CRC project knowledge, but there remains a concern among at least some industry managers that CRCs and their research partners cannot always achieve this *("I guess it's because we believe that [the CRC] as an organization can't keep information confidential", "We just don't believe they have the culture to do it ...."*). In the worst case, this industry perspective can become a major barrier to collaborating with a CRC on an R&D project, as indicated by one industry manager: *"... sometimes you feel this is all too much, [instead you should] get out of [the CRC] and fully fund [the research yourself] ... just forget it, you're fully funded and you're commercial controlled [so] forget the leveraging and forget everything else ..."*.

Finally, there was the issue of managing IP and research knowledge where the CRC has relationships with many organizations, and particularly where it carries out contract research for a number of companies (some of which may be competitors). This raises the twin management problems of maintaining project secrecy *(" ... we are negotiating a research contract with a major .. company ... they will own the IP and they are very concerned that there should be no mention in our reports as to the nature of the work or the progress of the work ... so that we can say we're doing a research contract in relation to [the company], but that's as much as we can say"*), and of ensuring there is no leakage across projects within the CRC *(" ....we've had to be able to show .. companies who want us to do contract research with them that there is a rock solid firewall and it stops transfer of information. So we have not had a scenario where there has been a transfer of knowledge inappropriately from one area to another"*).

Conclusion

Since its inception in 1990, there has been a growing acceptance of the CRC Program within the policy arena, the university sector and industry. There has also been an increasing recognition among the main players in the public and private sectors of the benefits offered by the program. However our research to date has confirmed that building commercially-focused cross-sector collaborations under the auspices of the program is fraught with difficulties, and that tensions across the sectors need to be managed carefully. As we have shown above, the issues associated with the management of IP reveal much about the trust dynamics in a cross-sector collaboration and they underline the "risky" nature of such collaborations. It is through management efforts to address these issues, and in so doing build trust among the partners and identify and manage the risks confronting a venture, that successful collaborative relationships are formed. But it should be emphasised that our research is still in its early stages. Much more work, both data collection and analysis, is required to confirm our initial findings, to investigate them in more detail, and to determine the extent of their generalizability from the cases studied. Through this research, we aim to make both theoretical and practical contributions. By investigating a specific form of IOC that has not been widely studied before, we hope to obtain valuable insights into the management of such voluntary cooperative relationships and so help address the problem arising from the diffuse, fragmented and often incoherent literature on IOC wherein the institutional dynamics of collaboration remain poorly theorised. The study will also contribute to practical outcomes through the identification of management practices and other factors that contribute to successful and sustainable collaborations.

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TABLE 1: Recognised Advantages of the CRC Program

Theme	***Illustrative Quotes***
Cross-sector collaboration creates synergies.	A synergy of expertise. The ultimate aim is synergy – value-adding ….
Researchers can gain more recognition by working within the CRC program.	Individuals recognising researchers. Recognition – instant benefits, publicity, funding …
The program fosters improved relationships with research users in industry and it increases the ability of users to engage with and exploit R&D.	A move away from a funding body approach to shared priorities for industry and research. Relationships with industry people, once established, seem to be stronger than those with other R&D institutions. An increase in the capacity of users to utilise R&D. Consolidation of the end-user community – they need to be multi-disciplinary too. Industry awareness of what research can do.
The program improves communication about research beyond the research community, i.e. to the Government and the community.	The CRCs are good at breaking down barriers between individuals and the government. Reduces fragmentation – CRCs are able to provide integrated responses on specific issues. Communication of science to a much broader audience. Communication activities are engaging the community generally, not just scientists.