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Collaborative R&D Project Partner Experiences in the Australian CRC Program: A Theoretical Framework

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A refereed paper accepted for Stream K (Technology and Innovation Management) at the 18th Annual Conference of the Australian and New Zealand Academy of Management (ANZAM), Otago University, 8 – 11 December 2004.
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Abstract
The paper focuses on commercially-oriented cross-sector R&D collaborative projects carried out within Australian Cooperative Research Centres. A theoretical model is proposed to explain the participants’ experience of such collaborative projects, and the relationship between partner experience and project outcomes. It is hypothesized that collaborative projects that have both a strong relationship focus, in terms of relational trust, and a strong task focus, in terms of project management capability, are more likely to be positively experienced by the participants. Four antecedent variables, derived from the literature and preliminary research, are proposed: credible commitments, previous collaboration experience, cross-sector management capability, and communication intensity. The model is to be empirically tested through a survey of CRC project leaders.

Keywords: R&D, interorganizational collaboration, risk, trust, credible commitments.

Introduction
Research on R&D collaboration is growing, yet the literature on cross-sector collaborations remains fragmented, is lacking in integration, and has a shortage of empirical data (Mora-Valentin et al., 2004). This paper contributes to the field of study by focusing on one type of cross-sector collaboration, namely that carried out by Australian Cooperative Research Centres (CRCs) engaged in the commercialization of R&D. The paper proposes a theoretical model to explain the factors that contribute to the collaboration experience of cross-sector R&D project participants. It is proposed to empirically test the model, and the hypotheses derived from it, through a survey of CRC project leaders. Such a model has not been developed to date, though various researchers have made moves in this direction (e.g. Bonaccorsi & Piccaluga, 1994; Santoro & Chakrabarti, 1999; Barnes et al., 2002).

There are at least four unique features of our study. Firstly, it focuses on cross-sector collaborations involving three types of organization (i.e. universities, public sector research agencies, and companies) as well as a “third party” brokering agency (the CRC), and this focus differs from the more usual study of university/industry or company/research agency partnerships. A second feature is that we are focusing on the project level, but we recognize that this is embedded within broader structures. Thirdly, we are interested in commercially-focused R&D projects, arguably those with the highest levels of risk for the partners. The collaboration risks involve relational risks as well as the risks inherent in R&D projects, and both have to be managed by the project participants. Fourthly, the projects we focus on involve multiple partners rather than
dyadic relations, and this moves our study beyond most of those reported so far.

While there is growing agreement on the factors that are important for effective cross-sector collaboration (e.g. Geisler, 1995; Davenport et al., 1999; Barnes et al., 2002; Mora-Valentin et al., 2004), there is no consensus on the critical dimensions of collaborations involving commercially-focused R&D carried out within entities such as CRCs. Such collaborations are very diverse, ranging from research contracts with clearly-defined objectives and short timeframes through to long term collaborative programs with more vague and flexible objectives. Any theory of this form of collaboration must address the specific issues arising from the commercialization of R&D (e.g. Rappert et al., 1999).

Projects comprise the focus of the study, rather than the CRCs per se, but we treat projects as “embedded” within a CRC because they are bound not only by the contractual agreements between the CRC partners and the Government, but also by the governance mechanisms peculiar to CRCs. CRC projects are usually proposed and managed by a sub-set of a centre’s partners and, while such projects are bounded in terms of objectives, budgets and timeframes, they are still exposed to the same relationship issues of trust, risk, opportunism and dependence that are found in all forms of collaboration. A distinctive feature of each CRC is the disparate nature of the stakeholders involved (encompassing both public and private sector partners), and the number and types of research programs the partners agree to establish. Contemporary organizational theory indicates that partners in collaborations are usually unequal in terms of resources and power, they may be more or less central to a collaboration, and their motives for collaborating can be quite diverse, factors which often lead to asymmetries in information and vulnerability costs as we discuss below. Yet the CRCs, and cross-sector collaborations more generally, are premised on the potential for creating complementary assets and relationships and so, in principle, they have an underlying ethos that sets them apart from other forms of collaboration (although the partners might find it hard to make this complementarity work; Bonaccorsi & Piccaluga, 1994; Santoro & Chakrabarti, 1999). So, because the CRCs are made up of diverse stakeholders, it cannot be assumed that goal congruence is achieved simply through the signing of contracts or project agreements.

We decided not to formulate a developmental or formation process model of interorganizational collaboration, as this has already been addressed (e.g. Ring & Van de Ven, 1994; Boersma et al., 2002; Daellenbach & Davenport, 2004). Instead, we focus on projects that are at, or beyond, the stage where the partners have decided to enter into a commitment (Boersma et al., 2002), and have already had to make commitments to the project. Moreover, while we initially sought to explain project outcomes (e.g. in terms of performance measures), we subsequently decided to focus on the participants’ collaborative experience, i.e. a subjective measure of the participants’ attitudes towards the collaboration (Genefke, 2001; Jap, 2001). Studying tangible project outcomes is difficult due to time-lags, whereby commercialization is achieved over a long period and often outside of the timeframe set by the immediate project objectives. Although we postulate

that there is a positive relationship between participants’ attitudes and successful project outcomes, we will only develop this part of our work in a speculative fashion.

**The Proposed Theoretical Model**

The model (depicted below) proposes that a cross-sector R&D project, which has both a strong relationship focus (in terms of 3 forms of relational trust, i.e. contractual, goodwill and competence, among those engaged in the project), and a strong task focus (in terms of project management competence of the project team), is likely to be seen in more positive terms by the project participants. The model also proposes four antecedents to the two independent variables. Firstly, there are “credible commitments” which are decisive in R&D projects generally. These forms of commitment, which vary in scope and intensity, provide tangible proof of trusting in a partnership. Credible commitments involve making pledges (e.g. commitment of funds and in-kind contributions) or taking hostages (e.g. building penalties into the agreement), and are characteristic of equity-based partnerships (Williamson, 1983; Gulati, 1995; de Laat, 1997a). However, as theorized by de Laat (1997a), they become critical to the building of reciprocity and a sense of fair dealing, so act as proxies of trust. Credible commitments are a contributing factor to the success of collaborative R&D projects, and are even more important when risk is high and trust is uncertain. In using this construct, we are seeking to make an original contribution to the literature by providing empirical support for the proposition that credible commitments help project participants to manage relational risks and hence contribute to a positive collaboration experience. As we discuss below, relational risks are of several kinds and can only be managed if relational trust is established in a collaboration.
The other three antecedent variables in the model were similarly derived from a review of the literature on interorganizational collaboration, and notably that on collaborative R&D (e.g. Ring & Van de Ven, 1992, 1994; Nooteboom, 1999; Barnes et al., 2002; Santoro & Chakrabarti, 1999; Boersma et al., 2003; Davenport et al., 1999; Das & Teng, 2001; Mora-Valentin et al., 2004; Daellenbach & Davenport, 2004). Firstly, it is now widely recognized that the participants’ previous experience of working together on collaborative projects contributes to the building of trust among them (e.g. Gulati, 1995), but it can also lead to learning which improves project management capability among the partners (Davenport et al., 1999). Secondly, on the basis of practical work aimed at the design and management of effective collaborations (Couchman & Beckett, 2001), and other studies of interorganizational partnering competence, we propose that a high level of cross-sector collaboration capability (i.e. the ability of the participants to manage the issues arising from the divergent cultures of private and public sector organizations), will lead to higher levels of relational trust and project management competence. Thirdly, drawing on a diverse body of research on communication in collaborative activities (e.g. Brown & Eisenhardt, 1995), we propose that communication intensity among the participants will also contribute to higher levels of relational trust and project management competence.

**The Dependent Variable: Partner Experience of CRC Projects**

Most studies of cross-sector collaboration focus on outcomes in terms of the success of the partnership overall, and often use performance measures that are difficult to validate or apply to CRC projects (Bonaccorsi and Piccaluga, 1994; Geisler, 1995; Brockhoff & Teichert, 1995; Santoro & Chakrabarti, 1999; Barnes et al., 2002;
Mora-Valentin et al., 2004). Measuring the effectiveness of collaborations is a complex problem and, as we noted above, the project outcome we seek to explain is a subjective measure of the participants’ attitude towards the collaboration rather than an objective measure such as number of publications or quantity of intellectual property created (although we postulate that there is a positive relationship between the attitude to a collaboration and project “success”). Our approach is similar to that taken by Jap (2001) who used the attitudinal construct of “relationship quality” to refer not only to a relationship evaluation by the participants (i.e. perceived satisfaction and outcome fairness) but also to future expectations of the relationship. Thus in the proposed model our dependent variable, collaboration experience, is based on perceived relationship quality and is made up of three attitudinal dimensions: (a) the extent to which the participants were satisfied with the collaboration, (b) the extent to which the participants perceived the collaboration outcomes to be fair, and (c) the extent to which the working relationship among the participants was seen to be sufficiently rewarding that further collaboration would be seen as desirable if the opportunity arose.

The Independent Variables

Relational Trust

Projects are established within a CRC and, because of their government funding, these agencies rely on contracts and an array of other risk-reducing mechanisms to ensure project accountability and to remedy non-performance. Equity alliances, on the other hand, require up front commitments, and are premised on tangible benefits in the form of a return on the partners’ investment. However, both forms of collaboration involve more than a simple hostage situation because they require a close interaction that over time enhances mutual awareness and social exchange (Gulati, 1995). Trust, as defined by Sako (1997), is based on an expectation that partners will behave in predictable and mutually acceptable ways. In this view, trust is a multi-faceted construct based on a predictability of behaviour that gives rise to three forms of trust. Predictability is associated with stability and consistency of behaviour, and the confidence that a partner will act in the future to produce beneficial outcomes (Gulati, 1995; Davenport et al., 1999). One of the three forms of trust is contractual trust, and is premised on the belief that partners will adhere to agreements and keep promises. The second form, competence trust, develops in relation to the dependability associated with the expertise, know-how, ability and performance of partners in actually meeting targets and obligations as distinct from an intention to perform (Sako, 1997; Das and Teng, 2001). While competence-based trust focuses on immediate risk reduction, it nonetheless is important to building relational trust over time as confidence in a partner’s loyalty, integrity and honesty builds (Davenport et al., 1999).

Expectations of positive outcomes in longer-term partnerships can only arise from a form of trust associated with the partners proving themselves to be equitable, fair in their dealings, having high integrity and standards of conduct, reciprocating favours, and acting in ways that go beyond the formal agreement to benefit...
the partnership. This is goodwill trust, the third form identified by Sako (1997). This form can only develop over time and through repeated successful encounters and, if sufficiently strong, can lead to “handshake” agreements. For collaborations to continue over time, trust relations have to have their own dynamics and become ingrained in the routines and practices of the collaborating entity and the partners within it (Dodgson, 1993). This type of trust transcends individual relationships and is embedded in organizational routines. For cross-sector R&D collaborations we use the term relational trust to encompass these three forms of trust, where a high level of relational trust is associated with “respect for partner’s abilities, commitment based on belief in mutual benefit, and open and honesty in objectives” (Dodgson, 1993: 92), and this both reduces the perceived risks of collaboration and enhances the perceived quality of the relationship.

It is commonly accepted that in R&D partnerships which involve the commercialization of knowledge, trust not only encourages risk-taking as well as the sharing of proprietary information, it also mitigates the need for excessive controls in what is largely an unpredictable and uncertain area. Trust reduces the transaction costs associated with contracting and other legal means aimed at reducing the risks of opportunism in the formation of partnerships, though trust in a partner can be misplaced and betrayal is always a possibility (Nooteboom, 1999).

We hypothesize that (H1): The higher the level of relational trust (i.e. in terms of contractual, competence and goodwill trust) amongst the participants, the more positive will be the participants’ experience of the project.

Project Management Competence
A relationship focus is necessary but not sufficient to create a positive collaboration experience. Collaborative projects are established specifically to achieve particular goals, and for this a task focus – and its associated project management capabilities – among the project team members is essential. The importance of effective project management systems and procedures for the success of projects, and especially for projects with high levels of uncertainty and risk, has long been emphasized. This emphasis has been reinforced by the experience of many managers. Empirical studies of collaborative research projects have confirmed the central importance of project management (e.g. Barnes et al., 2002). Effective project management is a two-stage process. In the first, often referred to as project planning, objectives are clearly specified, timelines are defined, and tasks and resources are allocated among project team members. A clear specification of project objectives has been associated with cooperative relationship success (e.g. Mora-Valentin et al., 2004), and effective planning can ensure that partners’ expectations are made explicit and a community of common interests can be built and sustained. In the second stage, progress is monitored and corrective management action is taken if necessary. This is usually achieved through the institution of formal systems and procedures as well as through the management actions of a project manager or leader, whose role is often seen to be critical for project success.
(e.g. Dodgson, 1993). So, if project management is defined as “…. the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project” (Project Management Institute, 1996: 6), then the more effective this process is the more satisfying will be the experience of the collaboration for the participants (the primary stakeholders) and the higher the likelihood that project objectives will be achieved.

*We hypothesize that (Hₐ²): The higher the level of project management competence in the project team, the more positive will be the participants’ experience of the project.*

**The Antecedent Variables**

**Credible Commitments**

The importance of commitments to projects, and collaborations in general, has been widely cited in the literature (Davenport, et al., 1999; Barnes et al., 2002; Mora-Valentin et al., 2004; Daellenbach & Davenport, 2004). However, our concept of credible commitments is applied to situations where there is a high level of risk, the possibility of partner opportunism and uncertainty of outcomes, as is the case for cross-sector commercially-oriented R&D projects. The concept was originally developed by Williamson (1983) and later refined by de Laat (1997a) to explain how R&D alliances between large corporations manage opportunism and develop trust. We propose that credible commitments are an important prerequisite for developing the trust that is critical to managing the relational risks of opportunism.

The fear of opportunistic behaviour - for example where partners appropriate proprietary knowledge, out-learn other partners or leak information to competitors - creates “boomerang hazards” in many R&D collaborations (de Laat, 1997b). But in CRC projects there are other relational risks. Relational risks can be seen as “vulnerability costs” that organizations need to prepare for as “…a premium for the risk involved in joining the collaboration” (Genefke, 2001: 26). In cross-sector collaborations vulnerability costs derive from two main sources: (a) structural dependence, and (b) information asymmetry. Structural dependence occurs, for example, when an external research partner is used for a long period of time and becomes a substitute for in-house capability. Information asymmetry occurs when one of the partners has less information about the collaborative venture than the others and faces the possibility of exploitation as a result. This “information dominance” creates an unbalanced relationship of dependence leading to the possibility that the more vulnerable partner becomes the victim of opportunistic behaviour. In R&D projects, information asymmetry is hard to manage in ways that are beneficial to all partners, and much harder if structural dependence favours one partner over the others. Credible commitments can be used to address such relational risks.

Credible commitments can be used either on their own or in conjunction with contracts to facilitate the sharing and protection of IP as well as the development of norms of reciprocity that help overcome relational
risks and build relational trust. One non-equity form of credible commitment identified by de Laat (1997a) is the establishment of protocols for information sharing. This was clearly evident in one of our preliminary case study projects, where a philosophy of “over dissemination” of information was delivered via a secure computer network and a general agreement was made to share information as openly as possible among the project personnel (Couchman & Fulop, 2004). Other forms of credible commitment include, for example, the development of systematic approaches to the organization of projects and an undertaking to make phased commitments to a project. Higher level commitments (i.e. those involving more costly undertakings) include joint equity in projects, the sharing of royalties, advanced investments from larger partners made before a project commences, the larger partner contributing a higher proportion of funds, and specific upfront contributions (of equity or resources) to a project.

Credible commitments, or acts of “pledging”, can lead to a spiralling trust based on “self-amplifying reciprocity”, which arises as partners build a track record of successfully executing their commitments and they therefore help build relational trust. More importantly, credible commitments also act as a form of “enforceable trust” by setting the norms of compliance as well as the sanctions for breaches of agreed commitments, and hence involve the reputational considerations of project participants (Gulati, 1995).

We hypothesize that (Hₐ₃): The more that credible commitments are made by the project participants, the higher will be the level of relational trust between them.

**Previous Collaboration Experience**

A recurrent theme in the interorganizational studies literature is that relational trust takes time to develop between partners; it is built incrementally and develops as organizations repeatedly interact (e.g. Gulati, 1995; Mora-Valentin et al., 2004). Previous experience of working together has also been identified as an important factor in the success of cross-sector collaborations (Geisler, 1995; Barnes et al., 2002). It is through “repeated ties” that organizations learn about each other (notably about who can be relied on in terms of competence and goodwill trust) and they build a range of commitments and bonds through social exchange (Dodgson, 1993). As Ring and Van de Ven (1992: 489) have put it: “Reliance on trust by organizations can be expected to emerge between business partners only when they have successfully completed transactions in the past and they perceive one another as complying with norms of equity. The more frequently the parties have successfully transacted, the more likely they will bring higher levels of trust to subsequent transactions.” Prior collaboration experience is not only important for the building of trust between participants, it also contributes to a learning about how to work effectively together (e.g. in the management of projects).

We hypothesize that: (Hₐ₄) The more the participants have worked together previously, the higher will be the level of relational trust (in terms of contractual, competence and goodwill trust) between them.

(Hₐ₅) The more the partners have worked together previously, the higher will be the level of project...
management competence in the project team.

Cross-Sector Management Capability

Cross-sector collaborations bring together participants with quite different cultures, interests, objectives, modes of operation, capabilities, timeframes, and commitments. It is therefore not unusual for the partners to have different expectations and priorities, and these differences may impact on the operation of a collaboration (e.g. Liyanage & Mitchell, 1994; Cyert & Goodman, 1997). In reviewing these differences, Couchman and Beckett (2001) identified four main tensions which need to be addressed during the initial negotiations between the partners and then managed throughout the life cycle of the collaboration. These tensions are those of (a) differing timeframes – the short term tangible deadlines of industry versus the longer term intangible deadlines of public sector agencies, (b) differences in knowledge sought – companies seek applied and commercially exploitable knowledge in contrast to scholarly knowledge, (c) a differing valuation of knowledge – knowledge as a commodity versus public good knowledge, and (d) disparate organisational cultures. Other studies have also noted the issues raised by these cross-sector differences (e.g. Geisler, 1995), it is generally agreed that management of them is essential to collaborative success, and the ability of the partners to manage the “cultural gap” has been postulated as one of the key elements in a “good practice model” for university-industry collaboration management (Barnes et al., 2002).

However, organizations vary in their ability to manage such cultural differences, the capacity to do so being dependent on the strategic orientation of the organization, its experience with this type of collaborative relationship, as well as the knowledge and skills of its employees. Drawing on the observation that there are substantial differences among companies in their ability to manage networks, Ritter and Gemünden (2003) propose the term “network competence” to refer to this capability which encompasses network management tasks (“necessary to manage a portfolio of relationships or a network as a whole”), and network management qualifications (the latter being an umbrella term for the skills, knowledge and qualifications needed to perform network management tasks). We propose that such a form of competence exists with respect to the management of cross-sector relationships, and that this varies across project participants. Those participants who have a high level of this capability are more likely to be able to build relational trust in collaborations because they are more likely to have positive expectations of their partners and be better able to influence the behaviour of partners, thereby reducing the likelihood of undesirable project outcomes (Das & Teng, 2001). Further, such participants will also be more likely to ensure that effective project management systems are established in a collaborative project because the knowledge and skills associated with this cross-cultural management competency will indicate the central importance of such systems for project success.

We hypothesize that: (Hₐ₆) The higher the cross-sector management capability in the project team, the higher will be the level of relational trust between the participants.

(Hₐ₇) The higher the cross-sector management capability in the project team, the higher will be the level
of project management competence.

**Communication Intensity**

The empirical literature on product innovation has long emphasized the importance of internal and external communication for new product success (e.g. Brown and Eisenhardt, 1995). Frequent internal communication among the members of a cross-functional project team ensures that important information is shared, misunderstandings are reduced, and team cohesion is built. External communication, between a project team and outsiders such as customers, suppliers and others with specialist knowledge, expertise or resources, has been found to be important both for building a capacity to absorb useful information and for political activities such as lobbying for support and resources. Communication has also been identified as a key attribute for successful interorganizational collaboration (e.g. Mora-Valentin et al., 2004) and university-industry research partnerships (e.g. Santoro & Chakrabarti, 1999). Open and frequent communication among research partners, with a full sharing of information (i.e. no hidden agendas or the hiding of information), helps manage expectations, reduces project risks and uncertainties, and contributes to the development of mutual respect and trust. We thus propose that frequent and open communication is an antecedent of relationship trust in collaborative R&D projects. Communication is also a necessary prerequisite for effective project management, as was clearly demonstrated in our case study of the “See3” project (Couchman & Fulop, 2004).

We hypothesize that: (Ha8) The higher the levels of communication amongst the project participants, the higher will be the level of relational trust between them.

(Ha9) The higher the levels of communication amongst the participants, the higher will be the level of project management competence.

**Discussion and Conclusion**

This paper represents the culmination of the first stage of an ongoing study. The next step is to empirically test the model through a survey of CRC project leaders (n = 400) across three sectors: Information and Communication Technology, Medical Science and Technology, and Manufacturing Technology. The survey will focus on commercially-oriented R&D projects that have been undertaken in the last three years, and which have either been completed or are near completion. Although there may be differences in the experiences that different participants have of a project, we believe that the project leaders are in the best position to assess a project team’s attributes (i.e. in terms of the constructs proposed in the model) and the overall experience of project participants. We know that we are dealing with a complex phenomenon, but we believe the model is sufficiently robust to go to the next stage of testing. As part of the development of the survey questionnaire, we...
will operationalize the constructs in the model, using existing instruments where these are available and appropriate (for a number of the constructs, however, no such measures exist).

We acknowledge that there are contingencies affecting all forms of collaboration, among which are: the type of R&D project in terms of its level of uncertainty; the number of partners in the project team; the industry in which the project is situated; and nature of intellectual property appropriation. However, we are not studying the CRCs per se, and have noted that it is common in research on cross-sector collaborations to confuse the entities studied (e.g. how a whole organization or a centre collaborates as distinct from collaboration at the project level). We conclude that these contingencies may indeed influence the explanatory variables (e.g. the building of relational trust may vary across industry and type of project, the nature of the required project management competence may be influenced by the level of R&D uncertainty and the nature of intellectual property produced), but we argue that they do not moderate the relationships proposed in the model and so we do not intend to consider them in the initial testing of the model (although in subsequent stages of survey data analysis we may explore the effects of various contingencies, e.g. as control variables in structural equation modelling).

We believe that we are among the first to try to empirically test such a model. Although a number of such models have been proposed to date, many are not in a form suitable for empirical testing and none so far have been subject to a rigorous empirical testing.

References


[1] The CRC Program was launched by the Australian Government in 1990 to support collaborative ventures which bring together researchers from universities, the public sector and industry. There are currently 71 CRCs operating in 6...
broad sectors of application (e.g. Manufacturing Technology, Medical Science and Technology).