Managing commercially-focused collaborative R&D projects: preliminary findings from an Australian survey

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Managing Commercially-Focused Collaborative R&D Projects:
Preliminary Findings From an Australian Survey

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ABSTRACT

Preliminary findings from a 2005 survey of Cooperative Research Centre (CRC) project leaders are presented. The results provide initial insights into the nature and outcomes of commercially-focused CRC projects. Such projects are modest in size and budget, are focused on producing new technologies, and are seen by the partners to be risky. Project teams tend to have the necessary project management capabilities and effective communication processes. The projects are experienced in positive terms by the partners, and positive collaboration experience is associated with positive project outcomes. The preliminary investigation of an initial sample is the first step in a more detailed analysis aimed at testing a theoretical model explaining the factors determining collaboration experience.

Keywords: R&D, cross-sector collaboration, Cooperative Research Centres

INTRODUCTION

This paper presents preliminary findings from a recent Australian survey of commercially-focused R&D projects carried out within Cooperative Research Centres (CRCs). The survey was part of an ongoing study of the management of risk in cross-sector R&D collaboration within the CRC Program (Turpin et al., 2001; Couchman and Fulop, 2004). The CRC Program, launched by the Australian Government in 1990 to bring together public sector research performers and users of research in industry, is part of a general trend of increasing cross-sector R&D collaboration which involves universities, public sector research agencies (e.g. CSIRO) and companies working together in consortia, partnerships and other forms of alliance. This trend has been stimulated by government policies which seek to improve cross-sector linkages (e.g. DEST, 2003) as well as the transfer of technology between public and private sectors, and also by corporate practices aimed at expediting the development of new technologies and the introduction of new products. But while this trend has been widely acknowledged (e.g. Turpin, 1997), the body of research on it – notably in Australia but also overseas – remains fragmented, is lacking in integration, and is beset by a shortage of empirical data. Furthermore, although the CRC Program has been evaluated a number of times in its life (e.g. Howard Partners, 2003), there have been relatively few empirical studies of its operation and management, especially at the project level where collaborative R&D is conducted. The study was designed to address these knowledge gaps, and in doing so it incorporated a number of unique features. Of
In particular, note it focused on commercially-oriented R&D projects (i.e. those which are established in order to achieve some commercial benefit for one or more of the partners), which were generally regarded to be of highest risk for the partners. However, despite an increasing policy emphasis on the commercial exploitation of public-funded research (e.g. DEST, 2002), commercialisation is a concept subject to different interpretations and the current increase in commercially-focused public sector research somewhat controversial (Coady, 2000; Kayrooz et al., 2001). A clearer understanding of the issues surrounding commercialisation at the project level within CRCs was sought through the study and the associated survey. The aim of this paper is to provide initial insights into the nature and outcomes of this type of collaborative R&D project by drawing on a preliminary analysis of the CRC survey data. This is the first time that such rigorous quantitative data on the management of CRC projects has been collected.

METHODS

A questionnaire was designed to test a theoretical model that had been developed to explain the collaboration experience of cross-sector collaborative R&D project participants (Couchman and Fulop, 2004). There were 7 constructs in the model, and a first step in the questionnaire development was to operationalise these constructs. This was achieved by, wherever possible, using and/or modifying existing scales (e.g. that for collaboration experience), but for a number of the constructs no such scales existed (e.g. for credible commitments and project management capability) and so these were developed specifically for the survey. After the addition of questions to collect supplementary data (e.g. on the background of the respondents), an initial draft was pilot tested with 6 experienced CRC project managers. This resulted in some modifications, and the final questionnaire consisted of 19 questions, nearly all of which were closed and many of which were multi-item Likert-type scales (where respondents were required to reply in terms of a 6-point agreement scale). In completing the questionnaire, respondents were asked to focus on the CRC project that they had most recently completed as project leader in the last 2 years.

A sampling strategy was designed to access the target population which was defined to be: CRC
project leaders who had completed (or were soon about to complete) a CRC project that had been established with the intention of leading to some financial benefit (e.g. in the form of income or cost savings) for the CRC and/or at least one of its partners. The sampling frame of 456 potential respondents in selected CRCs (i.e. those most likely to be engaged in commercially-focused R&D and covering 5 of the 6 CRC sectors) was derived from publicly-available sources, which in some cases was confirmed and supplemented by CRC CEOs. The survey questionnaires were mailed out in April 2005 and an initial reminder letter was sent 2 weeks after the mail-out. A further stage of follow-ups is planned, but this paper reports on the response to the first stage of the sampling strategy.

**THE SAMPLE (n = 110)**

456 questionnaires were mailed out and, after the first phase of the sampling strategy, 93 had been returned as ineligible or otherwise “returned to sender”, and 110 had been returned in usable form by eligible respondents (a response rate of 30.3%). The respondents were a diverse cross-section of CRC project leaders. Nearly one half (49.5%) were employed in a university, 17.4% were from CSIRO, 8.3% from a CRC, only 5.5% were from industry, and 19.3% were from other (primarily research) organisations. Their experience as project leaders ranged from 1 to 26 years, with a median of 4 years (mean 5.2, standard deviation 3.2 years), and the number of projects they had completed as project leader ranged from 0 to 25 with a median of 2 (mean 3, standard deviation 3.1). Overall, these were reasonably experienced project leaders with 82.6% having 3 or more years experience and 61% having led 3 or more CRC projects to completion.

The sampled projects were also diverse, with 38.5% contributing to Agriculture & Rural Manufacturing, 22% to Information and Communication Technology, 19.3% to Manufacturing Technology, 12.4% to Medical Science and Technology, 9.2% Mining and Energy, and 3.7% to Environment. The expected project outcomes were as shown in Table 1, with an average of 2 outcomes listed per project.
In terms of the organisational mix, 82% of the projects had at least 1 university partner, 78% had an industry partner, 44% CSIRO, and 44% another organisation. Projects had between 1 and 18 collaborating organisations (mean 4.5, standard deviation 3.1), with the distribution skewed towards a smaller number of organisations. The size of the project teams varied from 1 to 65 people, with a median of 6 (mean 7.8, standard deviation 8.4), and 84% consisted of 10 or less personnel. Project budgets were relatively modest, with 73% having a total budget of under $1 million. The mean project duration was 2.6 years, with 43% having a specified duration of up to 2 years and only 14% of 5 or more years. In 38.5% of the projects the partners had never worked together on other CRC projects, whereas in 35% they had done so once or a few times, and in 26.6% had done so quite often or frequently. Perceptions of project risk (i.e. in terms of achieving some financial benefit) at commencement were particularly interesting: 12% were considered to be of negligible or very low risk and 30.3% of low risk in contrast to 59.8% which were seen as high or very high risk. In sum, a “typical” project in the sample contributed to 1 of 4 CRC sectors, expected to produce new technology products or processes (a probable explanation for the Environment sector for example not producing “typical” projects), had around 4 collaborating organisations (with at least 1 university and 1 industry partner), employed 6 personnel, had a budget of less than $1 million and a scheduled life of 2.6 years, had partners with little or no experience of working together, and was seen to be of high risk.

**PRELIMINARY FINDINGS**

**Credible commitments**

Our preliminary qualitative research indicated that “credible commitments” can be an important factor in the success of collaborative R&D projects. These forms of commitment, which vary in scope and
intensity, provide tangible proof of trusting among partners. They involve making pledges (e.g. the commitment of funds and in-kind contributions) or “taking hostages” (e.g. inserting penalties into an agreement; Williamson, 1983), and contribute to the building of reciprocity and a sense of fair dealing, so act as proxies of trust (de Laat, 1997). The extent of the use of credible commitments in the CRC projects was measured through a 7-item checklist: if a listed commitment had been made by the partners during a project, then respondents ticked the corresponding box. The responses were as shown in Table 2.

TABLE 2: Extent of Credible Commitments in Sampled CRC Projects

<table>
<thead>
<tr>
<th>Credible Commitment</th>
<th>% Cases (n = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement to share proprietary or commercially-sensitive information</td>
<td>67.0</td>
</tr>
<tr>
<td>Joint assignment or equal sharing of project Intellectual Property (IP)</td>
<td>57.0</td>
</tr>
<tr>
<td>Undertaking to invest in further development of project outcomes</td>
<td>40.0</td>
</tr>
<tr>
<td>Agreement to take joint equity in joint venture arising from project</td>
<td>23.0</td>
</tr>
<tr>
<td>Industry partner licenses back project IP to other partners</td>
<td>10.0</td>
</tr>
<tr>
<td>Exclusive partnership formed for future projects</td>
<td>9.0</td>
</tr>
<tr>
<td>Industry partner guaranteed to purchase project outputs</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Clearly credible commitments were important for this type of project, and all of the projects reported at least one had been made by the partners. The most commonly used of the commitments were information-sharing agreements (of low cost but requiring considerable trust among the partners) and the joint assignation of IP (often covered in CRC project agreements). The least common were the formation of exclusive partnerships (collaborating partners appear to want to keep their future options open in this context) and industry partner guarantees to purchase project outputs (an interesting finding given the motivation of companies to enter into this type of collaboration). The median number of commitments per project was 2 (mean 2.4, standard deviation 1.1), and the distribution was skewed towards a fewer number of commitments (i.e. 67% of projects had either 1 or 2). Subsequent analysis with the full sample will test the hypothesis that the more credible commitments are made by the project participants, the higher will be the level of relational trust between them.

**Project Management and Communication**

The importance of effective project management systems and procedures for the success of projects, especially for projects with high levels of uncertainty and risk, has long been emphasized, and
empirical studies of collaborative research projects have confirmed the central importance of project management (e.g. Barnes et al., 2002). We asked respondents to indicate their agreement (using a 6-point agreement scale where 1 = completely agree) with a set of 11 conditions for effective project management which had been derived from the project management literature (e.g. PMI, 1996). The question was posed in terms of the project team’s capabilities (i.e. “in managing the project, the project team was able to ensure that the project had ….”). Overall, respondents reported that their project teams did have the specified project management capabilities. The mean score for the 11 conditions was 2.1 with a standard deviation of 0.7, and only 9 project teams had a mean of over 3.0 (indicating that they did not have the capabilities). It seems that for nearly all of these cross-sector commercially-focused projects, in which the partners have a greater stake but also face higher risks, the need for effective project management has been recognised and the requisite capabilities deployed. The mean scores for the individual items ranged from 1.75 to 2.37, the lowest being for “well organised meetings” (2.37), “effective resource planning” (2.34), and “effective communication” (2.32) – the latter no doubt being areas where performance could be improved in many projects.

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. 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 and no hidden agendas, helps manage expectations, reduces project risks and uncertainties, and contributes to the development of mutual respect and trust. We measured project team communication in terms of a 7-item Likert-type scale, where the items were derived from the literature on communication effectiveness. Reliability analysis revealed that the scale had high internal consistency (Cronbach’s alpha was 0.91), and the mean score was 15.66 with a standard deviation of 6.15 indicating effective communication among the project teams. As with project management
capabilities, it appears that the importance of communication among team members is recognised for these projects. The mean scores for the individual items ranged from 2.03 (communication was “achieved through dialogues, not one-way flows of information”) to 2.52 (communication was open and transparent with no secrets or hidden agendas). The score on the latter item could indicate that for some of these commercially-focused projects, the secrecy associated with the protection of IP remains a problematic issue (nearly one quarter, 23%, of the respondents did not agree that there was open communication in their projects).

Project Experience and Project Outcomes

Most studies of cross-sector collaboration have focused 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 we decided to focus initially on a subjective measure of the participants’ attitude towards the collaboration. 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. Our construct of collaboration experience (which is a dependent variable in our model), 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. Modifying Jap (2001), we measured this construct using a 5-item scale. We found this scale to be reliable (Cronbach’s alpha was 0.89), and the mean score was 12.46 with a standard deviation of 4.41. This indicates that, overall, the experience of the participants in these projects (as reported by the project leaders) was positive. Individual item scores are shown in Table 3.
It is interesting to note that the item with the lowest mean score was that “the collaboration has more than fulfilled the partners’ expectations”. Twenty seven percent of the respondents did not agree with this statement, which could indicate a mismatch between expectations and experience for certain types of project, a phenomenon we will further investigate in subsequent analysis.

To supplement the subjective measure of collaboration experience, we also collected data on a range of project outcome items (again using 6-point agreement/disagreement scales, where 1 = completely agree). The results are as shown in Table 4.

<table>
<thead>
<tr>
<th>Outcome Item</th>
<th>Mean Score</th>
<th>Median</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of value &amp; use to partners created</td>
<td>1.93</td>
<td>2.00</td>
<td>0.92</td>
</tr>
<tr>
<td>Partners agreed project was successful</td>
<td>2.03</td>
<td>2.00</td>
<td>0.94</td>
</tr>
<tr>
<td>Project delivered within budget</td>
<td>2.03</td>
<td>2.00</td>
<td>1.06</td>
</tr>
<tr>
<td>Project objectives were fully met</td>
<td>2.29</td>
<td>2.00</td>
<td>0.98</td>
</tr>
<tr>
<td>Papers on findings published in academic journals</td>
<td>2.39</td>
<td>2.00</td>
<td>1.54</td>
</tr>
<tr>
<td>Atmosphere of trust created among partners</td>
<td>2.54</td>
<td>2.00</td>
<td>1.22</td>
</tr>
<tr>
<td>Commercially-valuable IP was created</td>
<td>2.56</td>
<td>2.00</td>
<td>1.35</td>
</tr>
<tr>
<td>Network created for information exchange</td>
<td>2.64</td>
<td>2.00</td>
<td>1.42</td>
</tr>
<tr>
<td>Partners learned to collaborate for subsequent projects</td>
<td>2.69</td>
<td>2.00</td>
<td>1.25</td>
</tr>
<tr>
<td>Project extended due to favourable results</td>
<td>2.79</td>
<td>2.00</td>
<td>1.67</td>
</tr>
<tr>
<td>Knowledge transferred for commercialisation</td>
<td>2.94</td>
<td>2.00</td>
<td>1.35</td>
</tr>
<tr>
<td>Transfer of learning on managing R&amp;D projects</td>
<td>2.98</td>
<td>3.00</td>
<td>1.36</td>
</tr>
</tbody>
</table>

Generally, the projects had achieved positive outcomes (as can be seen from the table, with the mean scores indicating some level of agreement on all items) and 93% of the respondents reported that the partners agreed their project had been successful. This could indicate that for this type of project, with all partners committed to achieving some defined material benefit and thus for whom the stakes are clear, the more commercially-focused CRCs have developed effective management processes to ensure desired outcomes. Such management processes would include, for example: effective project selection procedures (and the use of pilot projects) to ensure that only those projects with a high probability of success were initiated; project termination procedures to ensure that failing projects did
not persist and waste scarce resources (any such terminated projects would not have appeared in the sample); and effective project management procedures to ensure that supported projects stayed on schedule, remained within budget, and delivered on objectives (this latter proposition would appear to be supported by the findings on project management presented above).

Of particular interest to our study, an area where not all project leaders reported a positive outcome was “knowledge was transferred to one or more of the partners for commercialisation” (mean 2.94, standard deviation 1.62); nearly a third of the respondents (32.4%) disagreed with this statement. Cross-tabulation showed that while there was a statistically significant relationship between projects that had created commercially-valuable IP and projects where knowledge was transferred for commercialisation (chi-square with continuity correction = 8.107, p = 0.004), 20 of the 33 projects (60.6%) where knowledge was not transferred had in fact created commercially-valuable IP. This could have occurred (as indicated by comments provided with completed questionnaires) where an industry partner withdrew from the project before its completion, but there may be other circumstances leading to this situation.

When we formulated our theoretical model, we postulated that there would be a positive relationship between the project participants’ collaboration experience and project success. The initial sample data provided us with an opportunity to test this proposition in a preliminary way. The results of the initial correlations between overall project experience and selected project outcomes are summarised in Table 5.

<table>
<thead>
<tr>
<th>Project Outcomes</th>
<th>PP-MC (r)</th>
<th>Signif. (1-tail)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere of trust created among partners</td>
<td>0.720**</td>
<td>0.000</td>
<td>106</td>
</tr>
<tr>
<td>Partners agreed project was successful</td>
<td>0.693**</td>
<td>0.000</td>
<td>107</td>
</tr>
<tr>
<td>Knowledge of value &amp; use to partners created</td>
<td>0.642**</td>
<td>0.000</td>
<td>106</td>
</tr>
<tr>
<td>Partners learned to collaborate for subsequent projects</td>
<td>0.592**</td>
<td>0.000</td>
<td>106</td>
</tr>
<tr>
<td>Project delivered within budget</td>
<td>0.479**</td>
<td>0.000</td>
<td>106</td>
</tr>
<tr>
<td>Project objectives were fully met</td>
<td>0.455**</td>
<td>0.000</td>
<td>107</td>
</tr>
<tr>
<td>Transfer of learning on managing R&amp;D projects</td>
<td>0.317**</td>
<td>0.000</td>
<td>107</td>
</tr>
<tr>
<td>Knowledge transferred for commercialisation</td>
<td>0.246**</td>
<td>0.000</td>
<td>104</td>
</tr>
<tr>
<td>Commercially-valuable IP was created</td>
<td>0.168*</td>
<td>0.043</td>
<td>106</td>
</tr>
</tbody>
</table>

** Correlation significant at 0.01 level  * Correlation significant at 0.05 level
The results suggest that our proposition was indeed correct, as nearly all of the correlation coefficients show moderate to high associations between the variables with all significant at least at the 0.05 level. In other words, significant positive relationships exist between the participants’ project experience and key project outcomes; the more a project is seen as a positive experience by participants, the higher the likelihood that it will result in positive outcomes.

CONCLUSIONS: A DISTINCTIVE RESEARCH DOMAIN IN AUSTRALIA

The analysis has provided insights into an important aspect of Australia’s national innovation system that has been little studied to date. The CRC Program has become a major vehicle for, and the Australian Government’s largest single investment in, cross-sector R&D collaboration (Turpin, 1997; Turpin et al., 2004), yet we know surprisingly little about how this program operates at the project level, especially with respect to commercially-focused projects. Such projects tend to be relatively modest in terms of size and budget, are focused on producing new technology in various forms, and are seen to be risky by their partners. Perhaps because of these perceptions of risk, the partners do make credible commitments, and project teams tend to have the necessary project management capabilities as well as effective communication processes. The partners’ experience of the projects was generally positive, and this experience was associated with positive project outcomes such as perceived success and achieved objectives. However, there were also indications that commercialisation in the projects could be problematic for some, as revealed by the small proportion of projects which expected to achieve income through IP licensing.

In this paper, we have (of necessity) only skimmed the surface of the data analysis, and when interpreting the findings the usual caveats apply: firstly, this was a relatively small, incomplete sample and non-response biases cannot be ruled out; secondly, the data were the opinions of single respondents (project leaders) which may have introduced biases into the findings. Our next step is to improve the survey response rate up to at least 50%, thereby increasing sample size and reducing any non-response biases, and then to conduct a multi-variate analysis in order to test the hypotheses derived from our theoretical model.
Bibliography


