

# A Missing Variable: Evaluating the Institutional Impact from Participating in Government Supported Cross Sector R&D Programs

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**A WORKING PAPER IN PROGRESS**

## ABSTRACT

A key feature of government interventions in support of national innovation in recent decades has been investment in cross sector R&D programs. One of the mechanisms for such action has been the institutionalisation of collaboration through the creation of cooperative research centres. In Australia the cooperative research centres (CRCs) program has become one of the nation's biggest single budget S&T investment strategy. This has led to increasing efforts to evaluate the program in terms of its overall objectives, the objectives of individual centres and individual centre research programs. However, the institutional objectives of the partners involved in CRCs tend to have been ignored in the process. An important question is: to what extent is participation in CRCs impinging (either positively or negatively) on the partners separate (and potentially conflicting) objectives?

Typical R&D evaluation processes for cross sector R&D programs, in Australia and elsewhere, focus mainly on the objectives of the program – not the institutional partners. Yet for them, participation carries with it elements of risk. This includes organisational as well as financial risk. This paper focuses on the risks experienced by one category of partner in the Australian CRC program: the universities. Data are presented on the 62 CRCs that comprise the Australian CRC program collected over the past 10 years (since the program commenced). Outcomes from the CRC program over the past ten years are assessed in the context of the broader institutional objectives and expectations in the Australian higher education environment. Our analysis suggests that there are important 'risk' factors for universities involved in CRC participation. There are important S&T policy implications that follow. It will be important to take these issues into account in evaluation mechanisms and processes for assessing the full impact of government funded 'cross-sector' collaborative R&D programs.

### *Introduction*

One of the more pervasive features of national research policies in recent years has been the considerable amount of public funds directed toward national cross-sector research programs. Collaborative research programs have been one of the most stable and widely supported components of US research policy for at least three decades (Behrens and Gray, 2001, 179.). In Australia, South Africa, and Germany collaborative grants and block institutional grants have come to dominate research funding mechanisms (Van der Walt and Blankley 1999; Garrett-Jones and Turpin 2002). In some countries, such as Australia, collaborative research programs have become not only major components of the research system but also a major driving force in research policy debates.<sup>1</sup>

Not surprisingly there has been considerable pressure on funding agencies to evaluate the impact and outcomes from these investments. Universities and industry have reported a broad set of potential benefits. Yet somewhat surprisingly efforts to systematically collect evidence to show that assumed benefits do or do not occur have met with limited success. (Rogers 2001, 2). As a result the types of situations and organisational arrangements under which benefits are *most* likely to accrue and *for whom*, is still unclear (Hellstrom and Jacob 2000).

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<sup>1</sup> The CRC Association now holds annual meetings which are widely attended by senior policy advisors, among others, and focus on key national (an international) research policy debates.

This paper deals with research evaluation of the Australian Cooperative Research Centre (CRC) Program. The CRC program has been in place for ten years and has been a major focus for evaluation through that period. Our argument in this paper is that while methods and techniques for evaluation have progressed they still do not 'account' for one important issue. That is, the impact of cross-sector collaboration on the organisational structures and 'overall' objectives and performance of the research partners themselves. The group of partners we are concerned with here are universities and publicly funded research institutions. In particular, we are concerned with addressing the question of how collaboration, over time, contributes to pressures on organisational boundaries, disciplinary boundaries, career trajectories of the actors and institutions that comprise the CRCs. To put it simply, we are seeking to uncover to what extent, how, and under what circumstances Cooperative Research Centres are, for better or worse, acting as agents of organisational change.

The paper is organised in the following way. First, we outline the case for evaluating the role of CRCs as agents of change in universities and research institutions. This is followed with a brief description of the nature, objectives and general structure of the Australian CRC Program. We also sketch out the quite comprehensive approaches that have been taken to evaluation of the centres across the program as a whole.

This is followed with a discussion of the social context in which universities contribute to the program. We propose, from a theoretical point of view, a set of risks that these organisations confront in adopting a partnership role in the CRC program. Three potential areas of risk are identified: academic risk, scientific risk, and organisational risk. Attention is drawn to the implications this risk carries for researchers, disciplines and organisational structures within universities and research institutes. Our proposal is that current evaluation processes overlook the potential of CRCs to bring about change, either positive or negative in these areas.

In the concluding section that follows we review some of the data collected to monitor CRCs. This serves to illustrate ways that current evaluation methodologies might be utilised to identify areas where pressure to change, as a consequence of CRC involvement, is likely to be most acute.

### *Collaborative knowledge networks and collaborating institutions*

From a number of perspectives, a shift has been observed in the ways that academic research is organised (Ziman, 1994; Gibbons *et al*, 1994; Etzkowitz and Leydesdorff, 1997). An underlying feature of these observations is the increased influence of 'networks' in driving the knowledge production and diffusion process. (Hellstrom and Jacob, 2000, 96). Knowledge production taking place in complex networks depends on cooperation between interdependent parties whose interests, rationalities and strategies may conflict or converge (Hellstrom and Jacob, 2000, 99). This applies to cooperation between individuals as well as between organisations within the network. While a network of research communities might have clearly defined and articulated objective, these may not necessarily coincide with all of the interests of the institutions within which the members of the network are embedded. Thus networks themselves are an appropriate focus of evaluation. Are these changing? Are they being supported or are they becoming disengaged from institutional structures? With

respect to cross sector research evaluation the focus has tended to be either on networks that have been constructed by government funding, such as the CRC program, or on the institutions themselves. Evaluation rarely focuses on the interactions between both.

Yet there is growing evidence that the host institutions are being quite deeply affected by the trend toward networked research. The intrusion of commercial markets has placed different pressures on university research networks as their institutions adopt commercial business practices (Marginson, 1994). Some researchers have proposed that industry university research collaboration in commercially oriented activities has the potential to confuse the university's central commitment to the pursuit of knowledge and learning generally (Coady, 2000). Others have suggested that a decline in basic research and associated secrecy commitments in industry collaboration may undermine the innovation process (Feller, 1997,). Slaughter and Leslie (1997) in describing university change adopt the term 'academic capitalism', because it captures the inherent clash in cultures and value systems. They note that since the 1980s, globalisation has accelerated movements towards the market. These are deep-seated changes, they argue, '...where professional work began to be patterned differently, *in kind* rather than in degree' (Slaughter and Leslie, 1997, 5). John Ziman (1994) has proposed that the structural nature of these changes are such that it now makes sense to refer to 'post-academic science', while others have argued that the changes are so profound that they represent a new mode of knowledge production (Gibbons *et al*). Alternatively, Etzkowitz and Leydesdorff have theorised that negotiated alliances between universities, governments and industry have led to what they describe as a 'triple helix' of knowledge production. Underlying all of these perspectives is the recognition that the relationships between academic disciplines, universities and industry are undergoing a radical transformation.

The role of CRCs in this process as well as the implications *for* CRCs deserves some attention. Where possible, evaluation methods should seek to identify contributions or responses to such change. Recent work by Bozeman and colleagues suggest 'Human Value Mapping' through analyses of researchers in research centres offers one way to proceed (Bozeman, 2000). They also point out that a wide range of factors determine satisfactory outcomes for partners. They point out that it is not the act of technical partnership that should be considered effective or otherwise, but rather the technical strategy that underlies the partnership. This turns the focus onto business and organisational strategies (Bozeman and Wittner, 2001, 177. A pertinent question for CRC evaluation is how well do the technical strategies of CRCs align with the broader technical strategies of the institutional partners.

University organisational goals are often unclear and sometimes contradictory. Further, they are negotiated in highly contested organisational domain (Enders, 2002, 84). Enders has suggested that in response to this 'contest' universities can be observed as adopting a variety of strategies 'to seal of their core technologies from undue intentional or unintentional environmental influence' from external; environments (Enders, 2002 83). Others have drawn attention to the ways that such influences are not simply imposed from without but are part of a deep-seated internal response to changing market forces. Yet in spite of extensive debates about contemporary changes within universities empirical data to evaluate such change is extremely limited. Given the growth of the CRC program in Australia and the

potential of centres to act as agents of change it is appropriate to take this into account in program evaluations.

From an evaluation perspective Behrens and Gray have considered the organisational *cost* of cooperative arrangements (Behrens and Gray 2001, 180). In particular they are concerned with unintended consequences of collaboration through changes in social process. For example if concerns about the erosion of academic freedom are borne out there is the possibility of a backlash that will undermine the enterprise of cooperation that established the linkages in the first place. They have recently collected empirical data to assess the impact of university – industry collaboration on graduate training. One of the more difficult concepts they seek to bring to the fore is *organisational climate*. In particular, they are concerned with questions such as *how* and *under what circumstances* the organisational climate has changed and whether or not this has led to intended or unintended outcomes. All of these questions reinforce the need for more theoretically grounded understanding of these issues (Gray 2001, 197).

From a similar concern Hellstrom and Jacob have noted academic concerns that university and industry partnerships might restrict the ‘ability of universities to devote resources to welfare aspects of their function’ (Hellstrom and Jacob, 2000, 97). This suggests, they argue, the need to explore the possibility of a new system emerging around mutual interests across institutional structures. From a networks point of view here is always the potential for networks to become so closed or ‘thick’ that they present barriers to the further flow of knowledge. This reinforces the need to evaluate knowledge production in these networks and the extent to which coinciding benefits are emerging for all parties (Hellstrom and Jacob, 2000, 98).

Our concern is to elaborate on the extent to which research networks, in this case CRCs, steer or influence the goals, activities or strategies of their organisational ‘parents’. The problem is that traditional output indicators such as publications, funding grants, patents and the like show only codified outputs or inputs. They are not very informative of the social process through which knowledge is produced and used. Some researchers have suggested concepts that might be useful for this purpose. Hellstrom and Jacob, for example, have proposed the use of network concepts such ‘fertility’ (quantity of action); and ‘reach’ (extent of connections) to complement quantitative indicators (Hellstrom and Jacob, 2000, 103-4). These ideas are helpful, but the difficult task is to find ways to link such concepts to data that are reported on a regular basis.

Interestingly, evaluation mechanisms and indicators designed to assess the CRC program in Australia offers a starting point for assessing the influence of CRCs in bringing about organisational change. While at this stage they do not provide answers they do at least indicate where and what further data could be obtained.

In the following section we suggest an approach that might offer some ideas for further developed.

### *The Australian CRC Program*

The Cooperative Research Centres Program (CRC Program) represents the Australian Government's largest single investment in cross-sector (industry-university-government) R&D collaboration. It is widely credited with 'changing research cultures' and promoting increased and more effective cross-sectoral, multidisciplinary and multi-organisational research, technology development and commercialisation. Yet how, to what extent, and in what areas such change is occurring is not captured in the present evaluation framework.

Over its ten year existence, the CRC Program has been exposed to several major reviews. Individual Centres are also subject to regular assessment; at the application stage, through annual reporting requirements including Centre-defined performance indicators, through expert 2<sup>nd</sup> year and 5<sup>th</sup> year reviews, and after seven years, on termination or renewal of their funding. The Government is currently undertaking a further evaluation of the program.

### *The CRC mode of evaluation*

A great deal of statistical and qualitative data is available, both on individual Centres and on the Program as a whole. Some of this information has been formalised into a 'performance measures framework'. The present CRC evaluation approach provides an example of a strongly quantitative performance indicators framework. Over the 10-year life of the CRC Program, the performance measures framework—and the evaluation process more generally—has grown and evolved. This performance and evaluation framework may be taken broadly to comprise:

- The objectives of the CRC Program
- CRC Program Evaluation Criteria
- Centre selection criteria
- Centre performance indicators
- The Annual Report and annual reporting guidelines
- Statistical collections including the Management Data Questionnaire (MDQ)
- Evaluation guidelines and criteria issued for the 2<sup>nd</sup> and 5<sup>th</sup> Year Reviews
- Evaluation guidelines and criteria issued for the Year Review
- *Ad hoc* evaluations and reviews of the program.

A recent review of the framework concluded that the CRC performance and evaluation system was among the strongest in Australia, and on a par with international best practice. The strengths of the framework are its comprehensiveness, its flexibility in allowing Centres to set appropriate performance indicators, its clear guidelines on statistical and qualitative reporting, and its use of independent expert review panels (Garrett-Jones and Turpin 2002).

The framework for performance assessment (see Appendix 1) illustrates a comprehensive attempt to capture performance measures at two levels: (1) at the level

of CRC Program (where performance measures are related to the four main objectives of the Program) (Framework 1) and (2) at the level of performance indicators for the research Centres themselves. The latter comprise Core Centre Performance measures (Framework 2) (linked to the program level objectives mentioned above) and Data Indicators (Framework 3) tied to the same categories.

The framework is strongly quantitative, with most of the indicator data required being generated within the program itself (from the Centres, from program administration, and from the program review committees). We have argued elsewhere that CRC performance measures system could be usefully augmented by measures of external stakeholder satisfaction and impact (Garrett-Jones and Turpin 2002). Apart from this, the weaknesses of the framework are its complexity, and the (unintended) implication that performance statistics can ‘automatically’ inform top-level objectives without additional qualitative analysis.

Nevertheless, the data collected through the framework can be analysed to indicate areas where organisational change might be felt most acutely. Identifying areas where organisational pressures are strongest suggests areas where change, for better or worse, might be most likely to occur. Collection of further qualitative information and analyses can then be targeted more sharply.

#### *A Typology of Risk and a Framework for Analyses*

In order to provide a framework for assessing the impact of CRCs as agents of change it is helpful to consider three different types of risk. The management and organisational studies literature has tended to focus on four types of risk: ‘strategic risk’; ‘financial risk’; ‘managerial decision making risk’; and ‘project management risk’ (Baird and Thomas, 1985; McNamara and Bromley 1999).

The literature on change in academic institutions suggests three rather different (although associated) elements of risk. We refer to these here as three types of institutional risk: *academic risk*, *scientific risk*, and *organisational risk*.

Academic risk concerns the risk experienced by researchers themselves in their role as academic employees. Opportunities for career advances, opportunities for mobility and their general working environment are subject to what we define here as ‘academic risk’.<sup>2</sup> As Ziman has pointed out, in academic markets only a small proportion of the competent researchers in a particular field will contribute to real progress in the field (Ziman, 1991, 55). The risk that academics take in joining different research groups or networks is whether they will be in a collective position to be part of that small proportion.

Scientific risk is used here to refer to the risk of change in the disciplinary structure of research and the domains within which it is carried out. The issue of interdisciplinarity and implications for disciplinary boundaries has been widely discussed elsewhere (Stehr and Weingardt, 2000). Our use of the term here is to draw attention to the struggles within university structures around disciplinary boundaries

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<sup>2</sup> Our use of the term draws on Ziman, 1989, (1994) and Bordieu, (1989) although we use the term somewhat differently here.

and the way these are managed within the university. (Turpin 1997, 1999). The risk of supporting a new and different set of research values and norms is that they may come to dominate existing academic values and expectations. As a consequence the objectives and focus of research and the ways it is judged may change in intended or unintended ways.

Organisational risk concerns the consequences of shifts in organisational boundaries occurring through the collaborative research process. There is an organisational risk that certain strategic actions might introduce unintended and adverse consequences and that these disturb the organisation's internal environment, performance and goals. If the risk is obvious then organisations can adopt risk management policies. Indeed most organisation, including universities, do this. However, our concern is more with risk from collaborative arrangements that are unknown or at least poorly understood.

From an organisational studies perspective Nooteboom (2000) has identified three important risks that universities confront. There is the possibility that research networks can become so tight and exclusionary that they might create inertia. Second, they need to build trust in two areas: competence and intention. Failure in one or the other will severely undermine future collaboration. There are also external conditions at work such as the over-arching regulatory framework as well as partners' management capacity. Thus organisational risk refers to the tension at the interface between the structure of networks and the structure of organisations in which they are embedded. While organisations clearly condition the formation of networks, once formed, there is the potential for reciprocal influence.

The ideas and concepts discussed above provide a framework identifying the *potential* impact of CRCs on the organisational structure of universities participating in CRCs. (see Table 1). In this framework the evaluation data drawn from the CRC Evaluation Framework are considered as intervening variables between the different risk factors and potential organisational impact.

In the concluding section evaluation data collected from the CRC program are used to illustrate how they might be used to sharpen our evaluation lens to focus on organisational impact.

**Table 1: A Tentative Framework for Assessing the impact of CRCs as Agents of Change**

Location of Boundary Pressures	Potential Variables	Organisational Impact
Academic Risk (Researchers)	'Standard' outputs as proportion of local departmental outputs ie publications, patents etc.	Support or barriers to career mobility  Changing performance measures
	Value of input from organisational contributors	Support or barriers to career progress



	Types of output compared to standard outputs.	Availability of resources
Scientific Risk (Disciplinary boundaries)	Outputs as proportion of general disciplinary outputs and departmental outputs.  Pre-defined 'value' of outputs.	Realignment of faculty boundaries  Interdisciplinarity  Changes in ex-ante research assessment
Organisational Risk (Structural boundaries)	Financial and staff inputs as proportion of university and research institutes by field	Partners' expectations of management capacity  Redefinitions of 'performance'  Changes in internal management structures

### *Assessing CRCs as Agents of Change*

#### Steering with outputs:

There are at least two ways that CRC evaluation can steer organisational change that might be identified from current evaluation data. One steering mechanism is through the nature of values placed on research inputs. This includes the quantity of inputs such as funding and human resources. It also includes types of inputs and their source. Some of the input data already collected through CRC evaluation mechanisms are shown in Figures 1, 2 and 3.

Figure 1 shows the trend for cash and in-kind contributions to the CRC program over the past ten years. The program as a whole has grown. However, in addition the proportional contribution from various partners has changed over time. For example, the proportional contribution from the CSIRO has dropped considerably. Industry contributions, previously well below the CSIRO are now nearly matching university contributions. State government proportional contributions have also increased.

Since 1997 the CRC evaluation data base has collected data on the number of industry partners formally involved in CRC activities. Figure 2 shows the number of partners over the past four years, according to field of research. These data show that some centres, for example those in the mining and energy fields, have a greater number of partners than those in information and communication technologies or agricultural and rural manufacturing. However, the latter group have considerably fewer industry partners than in 1997. It is quite likely that the drop in ICT and agriculture and rural manufacturing is associated with the drop in CSIRO contributions shown in Figure 1. But there appears to be some avoidance or withdrawal occurring in some fields and with some partners. Enders has suggested that some universities are experiencing change as 'blisters on the skin' and adopting 'plastering' strategies to cover them up

in order to protect their core competencies (Enders, 2002, 84). A closer qualitative investigation of the different experiences in mining and agriculture is likely to yield more insight into the extent and this might be occurring in relation to CRC participation.

Another input factor in CRC participation concerns staff numbers and their institutional affiliation. Figure 3 shows the full time equivalent staff inputs to CRCs from 1992 to 2001 by institutional affiliation. We are somewhat sceptical of the reliability of these data in the earlier years because of ambiguous instructions regarding their collection. The data for 2000 also appear problematic. Nevertheless, the data suggest a general increase for university inputs and a steady decline for CSIRO input. More recently, staff inputs from industry and other partners have increased.

### Steering Through Outputs

The outputs from CRCs provide an indication of what it is that they value. Output 'value' is clearly articulated in centre research and management plans. In the most recent collection of CRC output data centres were asked to nominate what they described as their most valued outputs. Apart from the typical research breakthroughs and advances made in their key fields a wide range of activities were nominated.

For example, the following outputs were defined by some CRCs as among their most 'valued' achievements.

A forestry CRC described their Forestry 'Tool Box', information sheets distributed at field days and agricultural shows as a significant output (rural manufacturing).

The sugar production CRC drew attention to what they described as the importance of information 'evenings' targeting industry journals, newspapers, radio, TV and internet. In addition, short professional courses have delivered training to 250 participants in the last year (rural manufacturing).

An agricultural research CRC noted that through their education programs over 150 farmers have completed an education module on land use, and water management (agriculture).

In contributing to their community awareness objective the CRC for conservation management initiated the 'Great Australian Marsupial Night-stalk' a community based spotlight surveys involving people of all ages from all over Australia (environment).

The Centre for Mining technology and equipment noted that they specifically targeted trade journals, magazines, newspapers as a key mechanisms for diffusing research outcomes (mining and energy).

The Aboriginal health CRC specifically targets Aboriginal health workers for professional training rather than typical PhD or Masters programs (medical health).

These are clearly valuable outputs in terms of the CRC objectives and are directly aligned with the Centres' objectives and strategies. The question is: how do they align

with the organisational priorities and structures that determine their careers? How do they align with the performance measures and the funding formulae imposed by the federal government and universities? Unless they are aligned involvement is a risky business.

Universities receive funding from the Federal Department of Education, Science and Training (DEST) on the basis of publication outputs and there are quite clear definitions of what 'counts'. What counts are journal articles, book chapters and books. To some extent other outputs such as creative works are also being included in the formal national list. Figure 4 shows CRC publications in DEST defined categories by area of CRC research. An interesting feature of these data is the comparative drop in publications since 1997. But noticeably the drop is more significant in some fields than others.

Figure 5 unpacks this trend further. Here the data show the types of publication output by field of research for 2000-2001. Overall publication outputs in mining and manufacturing were concentrated in unpublished industry reports. On the other hand outputs in ICT were concentrated in conference papers. For agriculture and environment fields the main concentrations were in book chapters and books and for medicine, journal articles predominated. This pattern may well mirror typical output patterns in their respective fields. However, it is possible to compare these patterns against national output data and more specifically to make comparisons with outputs from individual university faculties or schools. The extent to which variation exists would suggest points for potential 'academic', 'scientific' and 'organisational' tension.

Figure 7 shows a wider range of outputs according to field of CRC research. These data clearly show different patterns of output for different fields. The point however, is not the disciplinary difference but the extent to which the CRC might exert influence on departments, faculties or universities in different ways. The CRC outputs suggest what their network values. Data can potentially be retrieved to contrast this with departmental, faculty or university outputs in the same fields. The extent to which this does or does not align with university values suggests potential areas of organisational tension or concordance.

Where significant difference can be identified there are at least two possible scenarios for change and the resolution of tension. First, the CRCs may respond by placing higher values on the broader system's priorities. Alternatively, the CRCs may serve to change the performance and funding formulae that the system currently imposes on them. In Australia there is already some evidence that this is occurring. For example the Federal Government recently changed its research infrastructure funding formulae and significantly increased the weighting given to research contracts with industry. Earned industry funding now matches research council funding as a performance measure of research 'success'.

## **Conclusion**

It has been claimed that one of the outcomes of CRC funding has been their formative role in acting as agents of change in the university research system. However, there is

no empirical evidence to show how and to what extent and under what circumstances this is occurring. The questions are important because as government sponsored collaborative research programs have expanded so too has their potential to transform career patterns of researchers, the disciplinary boundaries in universities and the organisational structures and regulations that govern them. We have attempted here to find some way of assessing the impact of CRCs on organisational change and to incorporate this into a general evaluation framework.

The approach we have discussed here does not fully answer the questions we have posed. However, the variables typically collected in the CRC evaluation framework does help to indicate more precisely where we might look for qualitative data to find more comprehensive answers to such questions.

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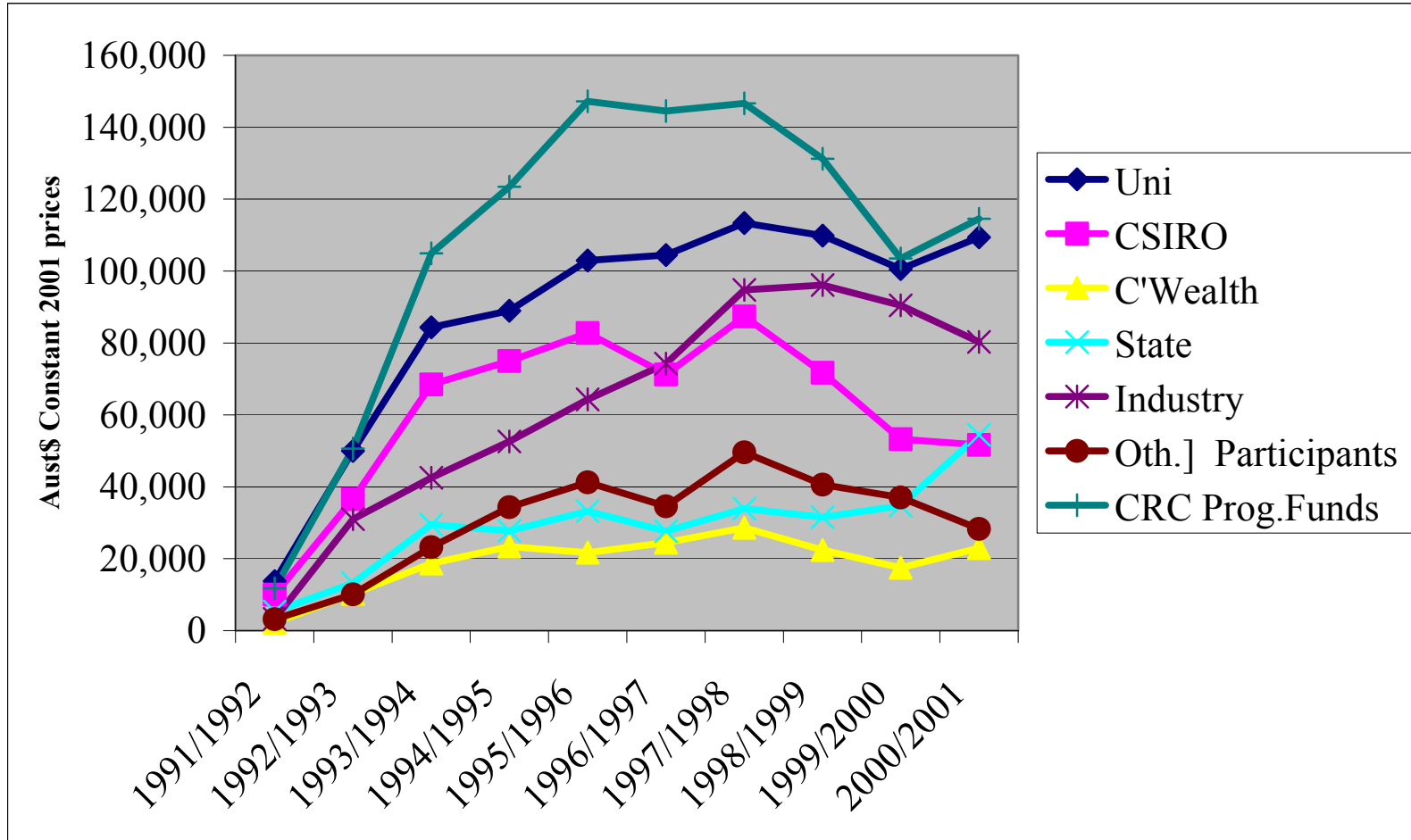
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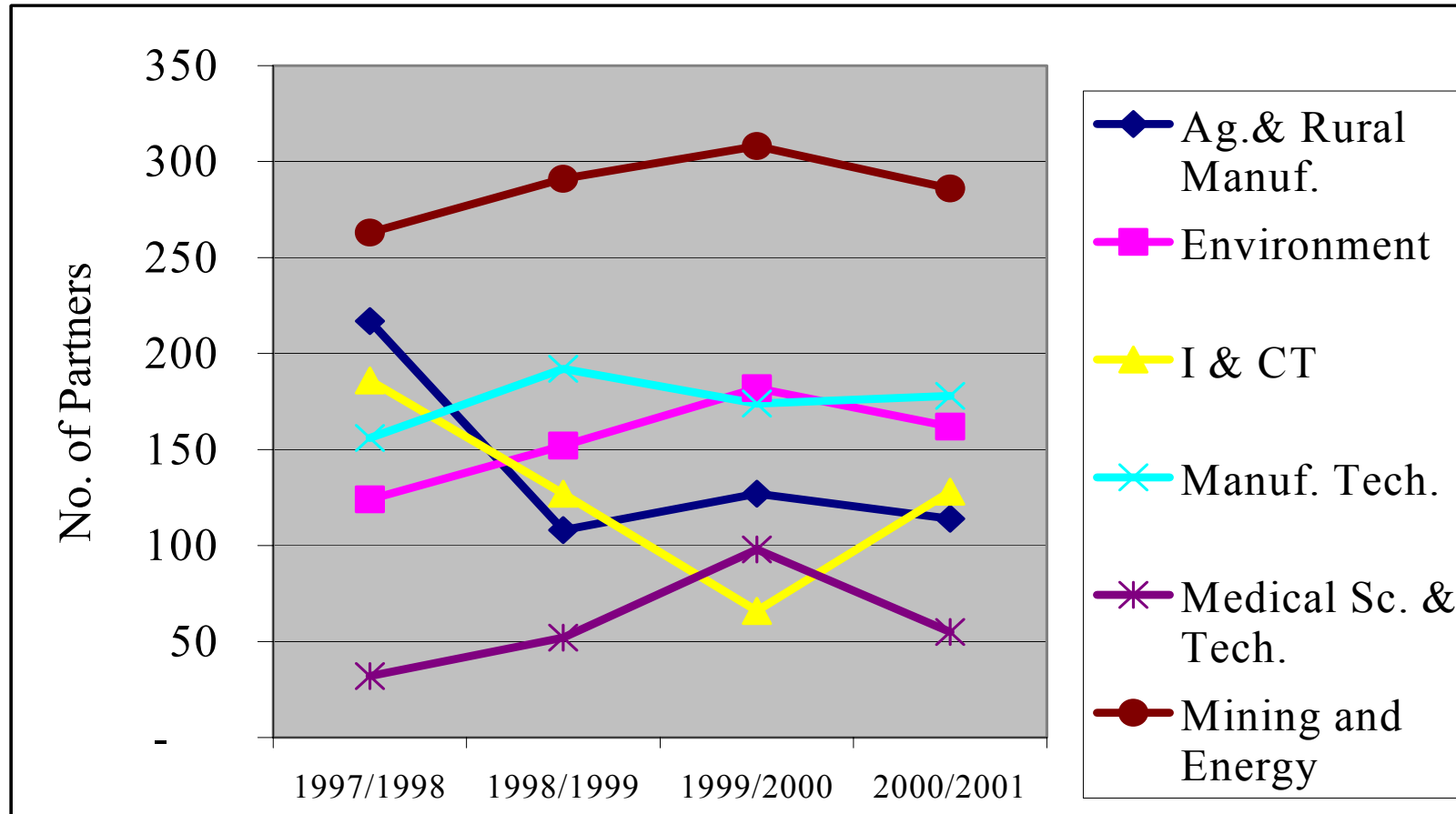
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Figure 1: Cash & in-kind contributions -all CRCs: 1991/2 - 2000/1



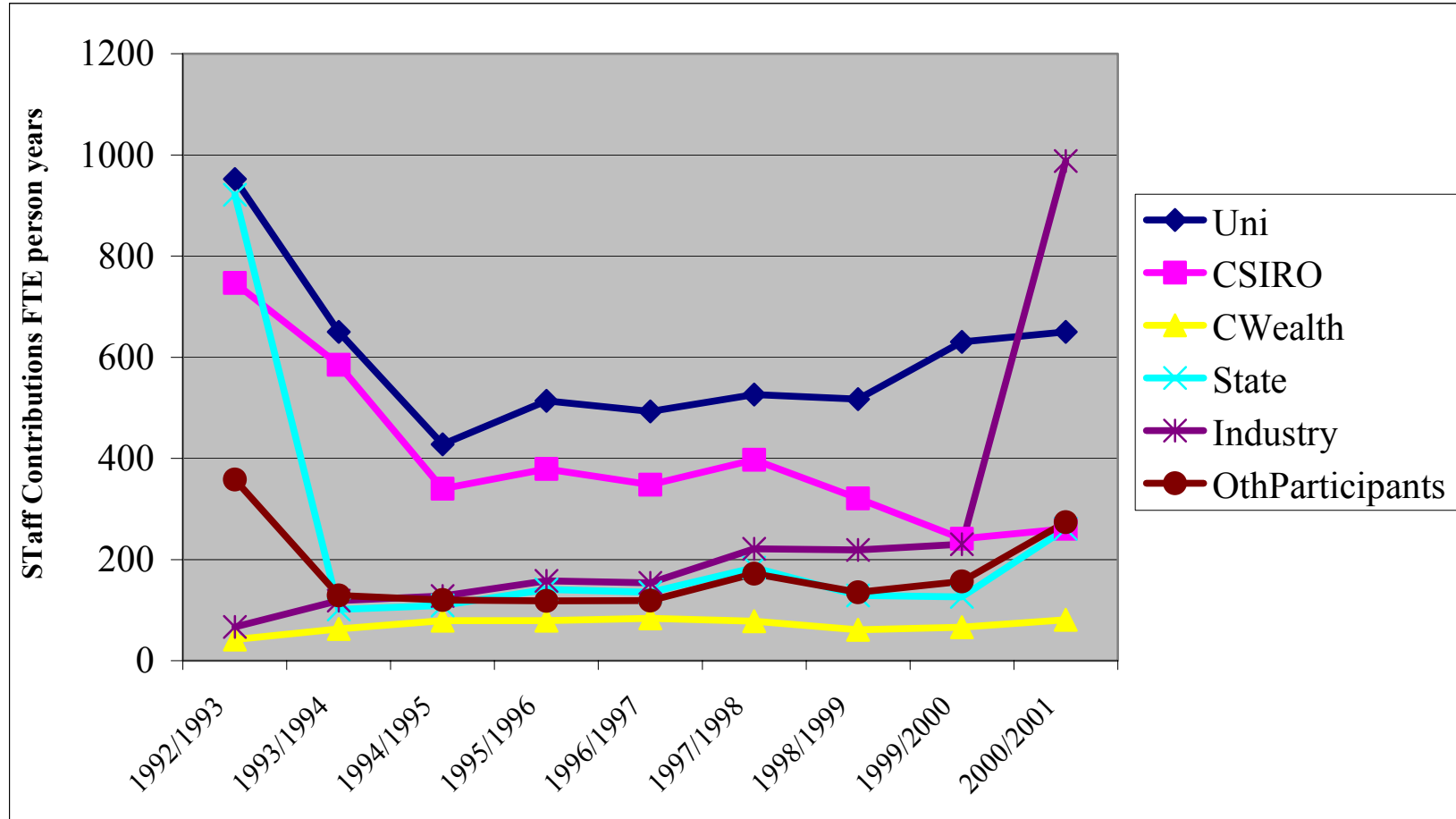
Source: Garrett-Jones and Turpin.(2002)

Figure2: CRC inputs - number of partners by research field: 1997/8-2000/1.



Source: Garrett-Jones and Turpin.(2002)

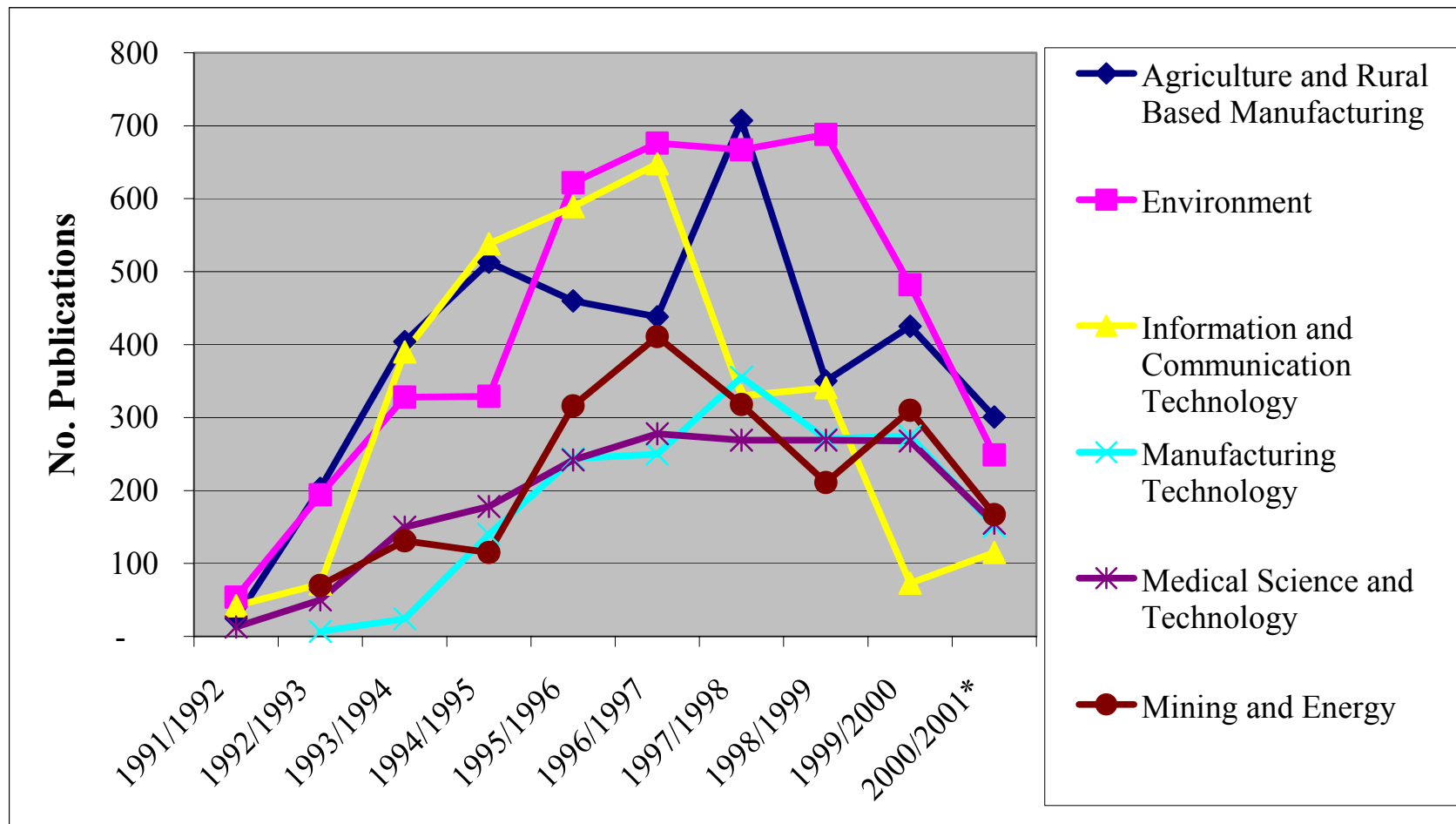
Figure 3: CRC Inputs – FTE staff by contributing sector: 1992/3 – 2000/1



Source: Garrett-Jones and Turpin.(2002)

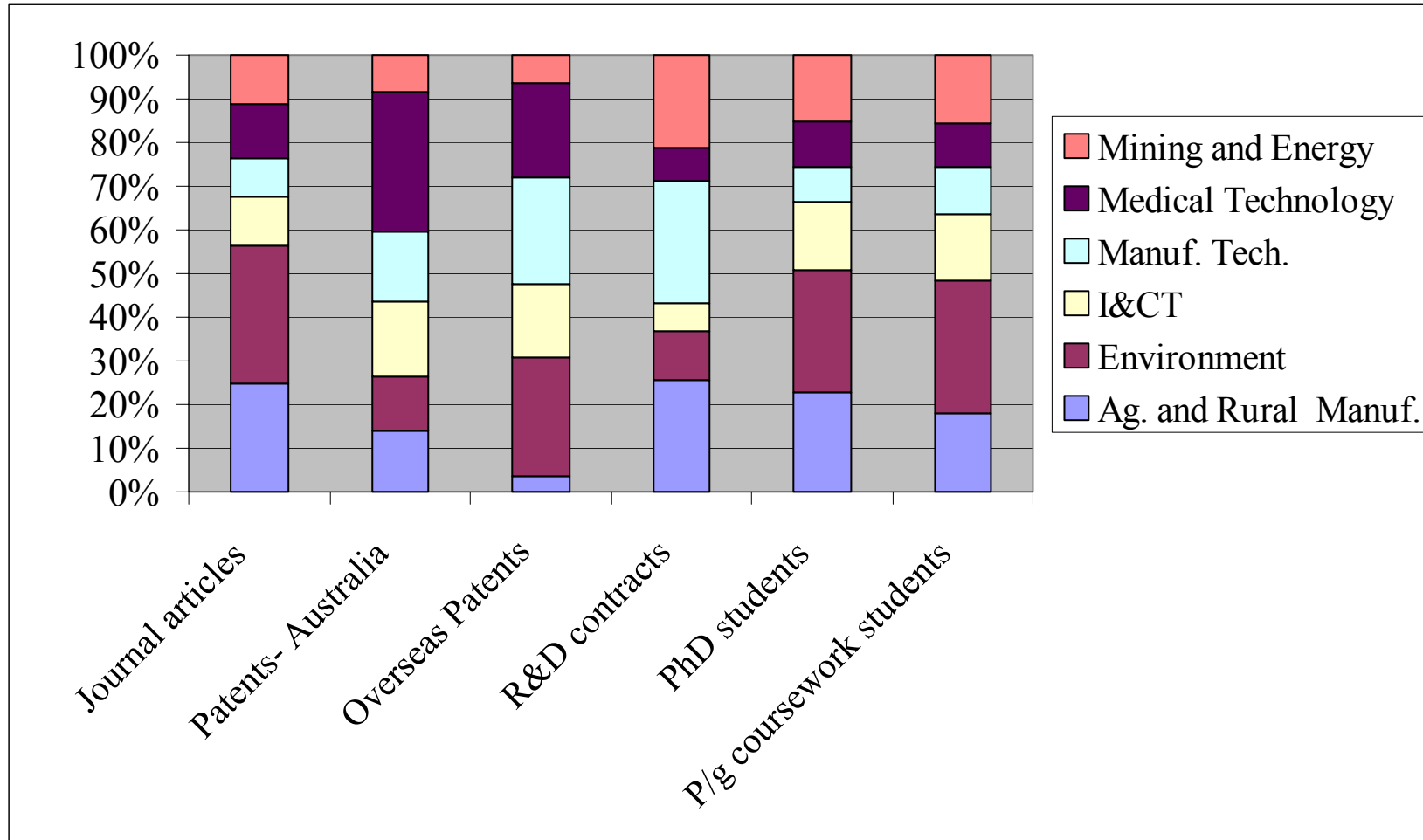


Figure 4: CRC publications output by area of research: - 1991 – 2001



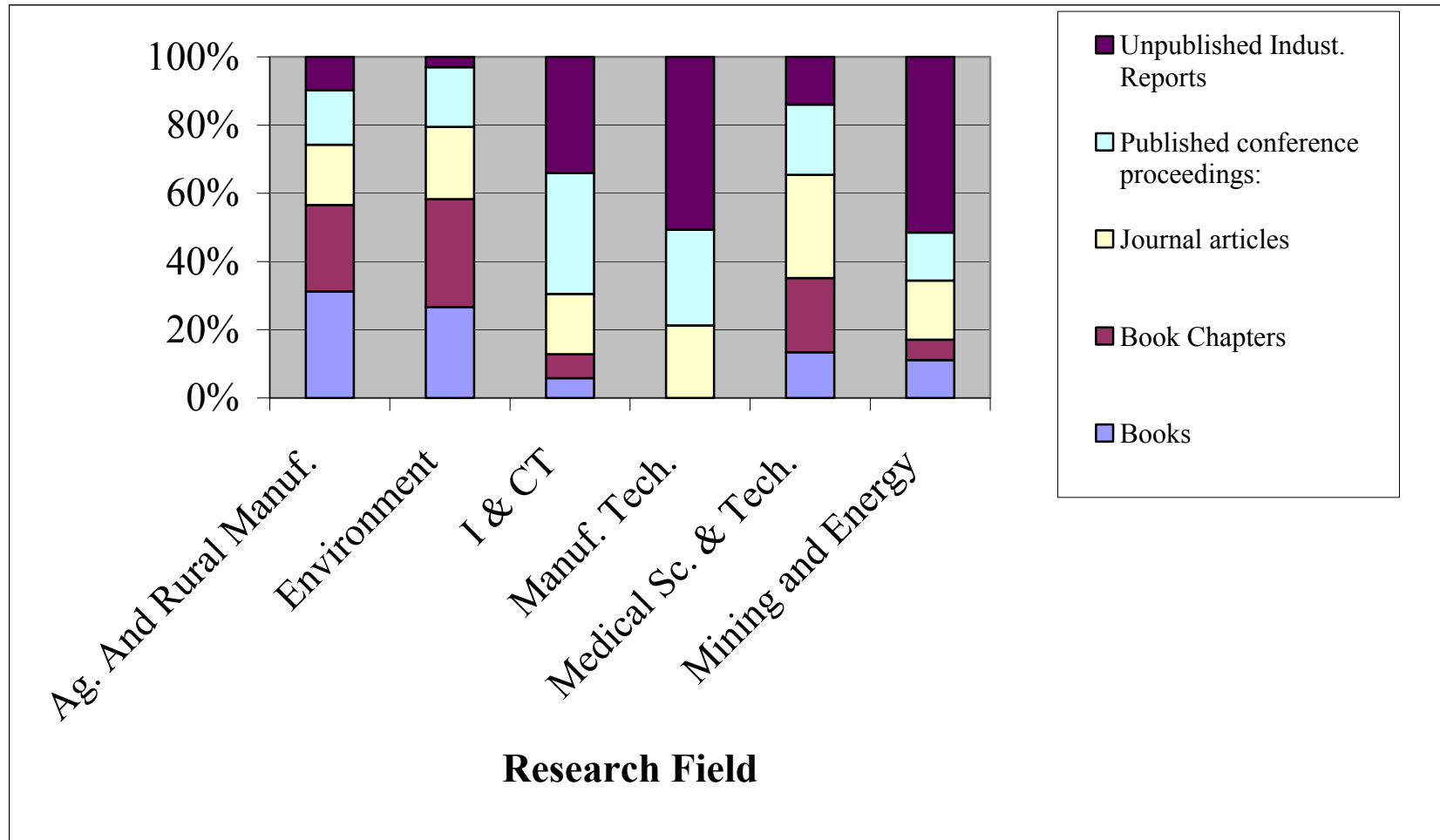
Source: Garrett-Jones and Turpin.(2002)

Figure 5: Types of CRC outputs by area of research: - 2000/1



Source: Garrett-Jones and Turpin.(2002)

**Figure 6: CRC Output by types of publications by research field: – 2000/2001**



## Appendix 1: Cooperative Research Centres Program Performance Measures Framework (2002)

### DEST CRC Revised Evaluation Procedural Framework 2: Core Centre Performance Measures (CCPM) –Schedule 6 of Commonwealth Agreement

<b>2.1</b>		<b>Objectives of the CRC - well defined addressing specific community and/or industry need;</b>
2.1.1	Outcome	<i>Qualitative statement on achievements and outcomes of Centre activities, especially those which can be identified as having a national benefit (200 words maximum)</i>
2.1.2	Input	<i>Centre level resources aimed at specific socio-economic objectives.</i>
2.1.3	Input	<i>Contribution of resources at CRC sub-program by SEO</i>
2.1.4	Structure	<i>Industry partner participation</i>
<b>2.2</b>		<b>Objectives of the CRC - outcomes make a significant contribution to Australia's sustainable economic and social development;</b>
2.2.1	Outcome	Qualitative statement of Centres' defined successful outcomes: research/teaching and community.
2.2.2	Outcome	<i>Dollar value of economic (value) benefit to Australia including where appropriate shadow costing of social and environmental benefits. (Include ROI when provided-provide information on methodology used to determine the benefits)</i>
2.2.2.1		Projected benefits from the Centre
2.2.2.2		Actual Benefits from the Centre (identified from 2 <sup>nd</sup> & 5th Yr Reviews, 7th year and 10 years after commencement)
2.2.3	Outcome	<i>Dollar value of economic benefits to all participants including where appropriate shadow costing of social and environmental benefits. (Include ROI when provided-provide information on methodology used to determine the benefits)</i>
2.2.3.1		Projected benefits from the Centre
2.2.3.2		Actual Benefits from the Centre (identified from 2 <sup>nd</sup> & 5th Yr Reviews, 7th year and 10 years after commencement).
<b>2.3</b>		<b>Quality and relevance of the research program;</b>
2.3.1	Outcome	<i>Number of peer reviewed publications</i>
2.3.2	Outcome	<i>Number of unpublished reports for industry users.</i>
2.3.3	Outcome	<i>Qualitative account of most successful research outcomes</i>
2.3.4	Outcome	<i>Successful peer reviews of research program (identified from 2<sup>nd</sup> &amp; 5th Yr Reviews, 7th year and 10 years after commencement).</i>
<b>2.4</b>		<b>Strategy for utilisation and commercialisation of research outputs</b>
2.4.1	Outcome	<i>Adoption of research outputs by industry or community generally</i>
2.4.1.1		- number of cases
2.4.1.2		- value to users (semi -quantitative)
2.4.2	Outcome	<i>Qualitative statement of successful technology transfer, commercialisation or application outcomes</i>
<b>2.5</b>		<b>Education and training</b>
2.5.1	Process	<i>Student enrolments, especially PhDs</i>
2.5.2	Output	<i>Student completions, especially PhDs</i>
2.5.3	Outcome	<i>Training programs for industry</i>
2.5.3.1		- number and income from training courses
2.5.4	Outcome	<i>Industry involvement in education and training</i>
2.5.4.1		- postgraduate research student supervision
2.5.4.2		- other education and training activities
2.5.5	Outcome	<i>Qualitative statement on successful education and training outcomes including employment of graduates in industry</i>
2.5.6	Outcome	<i>Number of students taking up employment with industry</i>

<b>2.6</b>		<b>Collaborative Arrangements.</b>
2.6.1	Process	<i>Percentage of projects with:</i>
2.6.1.1		<i>- more than 1 participant partner</i>
2.6.2	Structure	<i>Industry participation:</i>
2.6.3	Structure	<i>International collaboration</i>
2.6.4	Outcome	<i>Integration of research, teaching and commercialisation/application activities</i>
2.6.5	Outcome	<i>Qualitative statement of successful collaborative outcomes</i>
2.6.6	Outcome	<i>Level of leveraged non-CRC Program funding</i>
2.6.7	Process	<i>Qualitative information on strategy for continued collaboration once CRC funding ceases</i>
<b>2.7</b>		<b>Resources and Budget</b>
2.7.1	Input	<i>Total income from all sources CASH AND IN-KIND</i>
2.7.2	Input	<i>FTE research staff (excluding students)</i>
2.7.3	Input	<i>FTE technical and other support staff</i>
2.7.4	Input	<i>Cost per billable R&amp;D staff year</i>
2.7.5	Structure	<i>Proportion of sector contributions</i>
2.7.6	Outcome	<i>Growth in proportion of leveraged funding from non-program sources</i>
<b>2.8</b>	<b>Output</b>	<b>Management Structure</b>
2.8.1	Process	<i>Measured through the Review process</i>
2.8.2	Structure	<i>Seniority of Board Membership for respective participants in the CRC</i>
<b>2.9</b>		<b>Performance evaluation</b>
2.9.1	Output	<i>Operational management:</i>
2.9.1.1	Outcome	<i>No. of milestones met/not met</i>

### DEST CRC Evaluation Procedural Framework 3: Data Indicators – to assist the reporting requirements of Schedule 6 of the Commonwealth Agreement

3.1		Objectives of the CRC - well defined addressing specific community and/or industry need;	Source*	CRC-DB Report #
3.1.1	Outcome	<i>Qualitative statement on achievements and outcomes of Centre activities, especially those which can be identified as having a national benefit (200 words maximum)</i>	MDQ 2001 AR	
3.1.2	Input	<i>Centre level resources aimed at particular socio-economic objectives</i>	MDQ	1.1– 1.5
3.1.3	Input	<i>Contribution of resources at CRC sub program by SEO</i>	MDQ	
3.1.3.1		- research staff	MDQ	1.1– 1.5
3.1.4	Structure	<i>Industry participation.</i>	MDQ	
3.1.4.1		- core - supporting - other	MDQ	6.1/6.2/
3.1.4.2		- Large - SMEs	MDQ	6.1
3.2		<b>Objectives of the CRC - outcomes make a significant contribution to Australia's sustainable economic and social development;</b>	AR and Reviews	
3.2.1	Outcome	<i>Qualitative statement of Centres' defined successful outcomes: research/teaching and commercialisation.</i>	MDQ 2001 AR	
3.2.2	Impact	Cluster studies for groups of CRCs with similar objectives	DEST	
3.2.3	Impact	Standardised ROI analyses at the sector and centre level where appropriate	AR/Reviews	
3.3		<b>Quality and relevance of the research program;</b>		
3.3.1	Output	<i>Number of peer reviewed publications</i>		
3.3.1.1		- Number of refereed journal articles published	MDQ	3.1/3.2
3.3.1.2		- Number of books/chapters/ published (	MDQ	3.2
3.3.1.3		- Number of refereed conference papers	MDQ	3.2
3.3.2	Output	<i>Number of unpublished reports for industry</i>	MDQ	3.2/4.3
3.3.3	Outcome	<i>Qualitative account of most successful research outcomes</i>	MDQ 2001 AR	
3.4		<b>Strategy for utilisation and commercialisation of research outputs</b>		
3.4.1	Outcome	<i>Contracted research services and consulting</i>		
3.4.1.1		- number of cases	MDQ	4.5
3.4.1.2		- income to centre	MDQ	4.5
3.4.2	Outcome	<i>Technology agreements</i>	MDQ	
3.4.2.1		- number of cases	MDQ	4.4
3.4.2.2		- income to centre	MDQ	4.4
3.4.3	Outcome	<i>Number of spin-off companies</i>	MDQ	
3.4.3.1		- number of cases	MDQ	4.4
3.4.3.2		- income to centre	MDQ	4.4
3.4.3.3		-turnover ( annual – specify years since establishment)	AR	
3.4.4	Outcome	<i>Patents held</i>	MDQ	
3.4.4.1		- Australia	MDQ	4.6
3.4.4.2		- overseas	MDQ	4.7
3.4.5	Outcome	<i>Patents filed</i>	MDQ	
3.4.5.1		- Australia	MDQ	4.6
3.4.5.2		- Overseas	MDQ	4.7
3.4.6	Outcome	<i>Technology transfer courses</i>	MDQ	
3.4.6.1		- number of cases	MDQ	
3.4.6.2		- income to centre	MDQ	

<b>3.5</b>		<b>Education and training</b>			
3.5.1	Process	<i>Current FTE Student enrolments</i>			
3.5.1.1		- FTE PhD students	MDQ		5.1
3.5.1.2		- FTE Masters students (Research)	MDQ		5.2
3.5.1.3		- FTE Masters students (Coursework)	MDQ		5.2
3.5.1.4		- FTE Undergraduate students	MDQ		5.3
3.5.1.5		- number of undergraduate education courses	MDQ		5.3
3.5.2	Output	<i>Completions</i>			
3.5.2.1		- PhD	MDQ		5.1
3.5.2.2		- Masters (Research)	MDQ		5.2
3.5.2.3		- Masters (Coursework)	MDQ		5.2
3.5.2.4		- Undergraduate	MDQ		
3.5.3	Outcome	<i>Number and value of professional training course</i>	MDQ		
3.5.4	Process	<i>Percentage of students</i>			
3.5.4.1		with non university co-supervisor (recognised by university)	MDQ		5.5
3.5.5	Outcome	<i>Qualitative statement on successful education and training outcomes, including on graduate employment</i>	MDQ-		
3.5.6	Outcome	<i>Number of students taking up employment with industry</i>			
3.5.6.1		Number of CRC graduates taking up employment with industry or other users	MDQ		5.4
<b>3.6</b>		<b>Collaborative arrangements</b>			
3.6.1	Process	<i>Proportion of research projects with staff from more than one participating organisation</i>	MDQ		
3.6.2	Structure	<i>Industry Participation</i>			
3.6.2.1		- number of core participants (Large/SME)	MDQ		6.1/6.2
3.6.2.2		- number of supporting participants (Large/SME)	MDQ		6.1/6.2
3.6.2.3		- number of other participants (Large/SME)	MDQ		6.1/6.2
3.6.3		<i>International Collaboration</i>			
3.6.3.1		- number of strategic international alliances (by country, and potentially by type of organisation or alliance)	MDQ		6.3
2.6.4		<i>Integration of research, teaching and commercialisation/application activities</i>			
2.6.4.1		Qualitative statement on successful research, teaching and commercialisation/application activities	MDQ 2001 AR		
3.6.5	Outcome	<i>Qualitative statement of successful collaborative outcomes</i>	MDQ 2001 AR		
3.6.6	Structure	<i>Level of leveraged cash and in-kind contribution</i>	MDQ/AR		
3.6.6.1	Outcome	Growth in proportion of 'levered' cash and in-kind contribution	MDQ/AR		7.1/7.2
<b>3.7</b>		<b>Resources and budget</b>			
3.7.1	Input	<i>Total income from all sources CASH AND IN-KIND</i>	MDQ		7.1/7.2/7.3
3.7.2	Input	<i>FTE research staff (excluding students)</i>	MDQ		7.1/7.2/7.3
3.7.3	Input	<i>FTE technical and other support staff</i>	MDQ		7.1/7.2/7.3
3.7.4	Input	<i>Cost per billable R&amp;D staff year</i>	MDQ		
3.7.5	Structure	<i>Proportion of 'levered funding' compared to allocated CRC Program funds</i>	MDQ		7.2
3.7.6	Outcome	<i>Growth in proportion of leveraged funding from non-program sources</i>	MDQ		7.2

\*Note: MDQ = Management Data Questionnaire; AR = Annual Report

# Note: Identifies the report query to produce appropriate tabulation in the MDQ data-base module.

