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# A jack of all trades? - aligning policy, mission and structure in cooperative research centres

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## Publication Details

Garrett-Jones, S. E. & Turpin, T. (2009). A jack of all trades? - Aligning policy, mission and structure in cooperative research centres. Triple Helix VII - 7th Biennial International Conference on University, Industry and Government Linkages: The Role of the Triple Helix in the Global Agenda for Innovation, Competitiveness and Sustainability (pp. 1-6). Glasgow, Scotland: European Consortium of Innovative Universities.

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# A jack of all trades? - aligning policy, mission and structure in cooperative research centres

## **Abstract**

The Cooperative Research Centres (CRC) program has become the dominant model for "triple helix" cross-sector R&D cooperation in Australia. By comparison with more specialised programs in other countries the CRC program covers a very broad range of fields and objectives and might be described as a "jack of all trades". We argue that this "one size fits all" approach has become a limiting factor in the further development of cross-sector collaboration. Based on a range of prior empirical studies of CRCs we explore the environmental factors which shape the organizational structure of CRCs and identify the points of flexibility required to accommodate the range of missions and structures observed within the centres. Four broad influences are important in shaping the structure of CRCs. These are the changing policy focus of the CRC program; the diversity of missions, objectives and outputs of the CRCs; the expectations of researchers within CRCs which emphasise scientific careers and collegiality; and complementary changes in the innovation system which have led to a diversification of collaborative research. We conclude that the mature CRC program must take on a reinvigorated role and we make specific proposals to ensure that CRCs continue to lead the innovative organization of cross-sector research in the future.

## **Keywords**

policy, mission, structure, cooperative, research, centres, all, trades, jack, aligning

## **Disciplines**

Business | Social and Behavioral Sciences

## **Publication Details**

Garrett-Jones, S. E. & Turpin, T. (2009). A jack of all trades? - Aligning policy, mission and structure in cooperative research centres. Triple Helix VII - 7th Biennial International Conference on University, Industry and Government Linkages: The Role of the Triple Helix in the Global Agenda for Innovation, Competitiveness and Sustainability (pp. 1-6). Glasgow, Scotland: European Consortium of Innovative Universities.

# **A Jack of all Trades? – Aligning policy, mission and structure in Cooperative Research Centres**

## **1. Introduction**

The Cooperative Research Centres (CRC) program is Australia's most longstanding national arrangement for industry-university-government research collaboration. Over the 18 years of the program it has grown to become the dominant model for 'triple helix' cross-sector R&D cooperation in the country.

CRCs were first funded in 1990, following the example of centres like the US NSF Engineering Research Centers and the UK Science and Engineering Research Council's Interdisciplinary Research Centres in the mid 1980s. Over the eleven rounds of funding the program has established 168 centres: 102 as new centres (each funded for a seven-year term, renewable in some cases) and 66 formed from pre-existing CRCs (O'Kane, 2008). There are currently (Sept. 2008) 49 CRCs in operation covering a wide range of industrially-oriented and 'public good' research. Annual government funding to the program of around A\$200 mill. accounts for about 3.5% of budget funding for science and innovation. Administered separately, government investment in the program is equivalent to about 20% of the budget of the two major research councils combined (DIISR, 2008a).

As a large, high profile public investment the CRC program has been subject to frequent review and modification. From the outset the program has tried to cover a broad range of objectives – from research concentration, graduate training and commercialization – across many of research and industry sectors. In the words of a recent program publication:

it will be clear that CRC research is a vast enterprise with numerous research programs intended to foster and maximise collaboration, international competitiveness, and innovation capacity for Australia's scientific and industrial benefit and environmental and social good (DIISR, 2008b: iv)

In short, it has become a 'jack of all trades'. This is contrary to the experience in large research systems, like the US, where cross-sector R&D centres have become more specialised. Here one finds a wide variation in organizational structures and in the way that management strategies are defined and driven among different kinds of centres. Steenhuis & Gray (2006) argue that it is the nature of the program with its specific technological and commercial objectives that attract specific drivers for strategy. Gray (2000) has also shown differences in the US between industry supported faculty researchers and those supported solely by government grants, suggesting two different sets of research experience. In Australian CRCs, because of their funding structure, both experiences coexist.

In this paper we argue that this 'one size fits all' approach has run its course and become a limiting factor in the further development of cross-sector collaboration in Australia. The most recent official policy review reaches a similar conclusion, envisaging CRCs that are 'diverse in structure, size and longevity'. It recommends that the program be 're-focused and modified' and that organizational arrangements be 'fit for purpose' so as to encourage 'fleet and flexible' CRCs (O'Kane, 2008: xv-xvi; xviii). However, the review fails to identify the relative importance of the factors that contribute to the heterogeneity of purpose within cross-sector R&D centres. Further, some of the review's recommendations appear to embed inflexibility, for example in relation to 'a common core of evaluation metrics' for the centres (O'Kane, 2008: xx).

We explore the environmental factors which shape the organizational structure of CRCs; and the points of flexibility required to accommodate the range of objectives observed within the CRC program. Essentially, we ask the question 'what factors might appropriately be considered when framing more specialised or flexible organizational structures for collaborative research' and what implications does this have for the future of the CRC program?

## **2. Methods and approach**

We have studied the CRC program from its early days and contributed to the ongoing debate on the role and management of the program. This work drew upon interviews with CRC participants and stakeholders; empirical work on developing performance indicator frameworks for a range of CRCs; and on wide scale surveys on the benefits and problems in CRC participation and in career tracks and expectations of researchers (Garrett-Jones &

Turpin, 2002; Garrett-Jones, Turpin, Burns, & Diment, 2005a; Garrett-Jones, Turpin, & Diment, 2009 in press; Turpin, 1997; Turpin, Garrett-Jones, & Diment, 2005). We have also examined the role played by smaller industry-linked research schemes in Australia. In this paper we reflect subjectively on data collected through these prior studies.

We consider four broad influences important in shaping the structure of CRCs:

1. The changing policy focus of the CRC program and the mixed messages this sends to participants;
2. The diversity of missions, objectives and outputs of the CRCs;
3. The declared expectations of researchers within CRCs which emphasise scientific norms, careers and collegiality; and
4. Complementary changes in the higher education, research and innovation system over the life of the program.

### **3. Factors influencing the structure of the CRCs**

#### **3.1 Policy shifts have changed the focus of the program**

The main objectives of the CRC program (as stated in 2002) have been to enhance the contribution of long-term scientific and technological research and innovation to economic, environmental or social benefit; the transfer of research outputs into commercial or other outcomes; to enhance graduate research, collaboration among researchers and between researchers and research-users; and improve efficiency in the use of research resources.

Within this ambit the emphasis on particular objectives has changed noticeably through the life of the program. An early driver was the inclusion of the large government research sector in formal arrangements for supervision of postgraduate students (Slatyer, 1994). In the initial rounds of CRCs an industry partner was 'strongly encouraged' but not mandatory (CRC Committee, 1991). Lately, in 2004 the then government insisted on 'a stronger commercial focus' and plans for commercialisation or utilisation. The mission became: 'to enhance Australia's industrial, commercial and economic growth through the development of sustained, user-driven, cooperative public-private research centres that achieve high levels of outcomes in adoption and commercialisation' (O'Kane, 2008). Current federal government policy is to reinstate 'public good' social and environmental benefit as key objectives (O'Kane, 2008). Initially restricted to science, medicine and engineering fields, currently 'there is no restriction on the fields of research that a CRC can undertake, but every CRC must include some research in the natural sciences or engineering' (DIISR, 2008b). The most recent review recommends that proposals in humanities and social sciences should also be encouraged (O'Kane, 2008).

There have been four comprehensive evaluations of the CRC program (CRC Program Evaluation Committee, 1995; Howard Partners, 2003; Mercer & Stocker, 1997; O'Kane, 2008) and CRCs have featured prominently in independent reviews of the research and innovation system (Cutler, 2008; Industry Commission, 1995; Productivity Commission, 2007). The CRC program receives strong support from industry, university users and the scientific community. The positive findings of the Myer report continued in submissions to the Stocker review: 'among the many strong points of the CRC program and the style of research it promotes... are ...changing the culture of research, promoting the value of research in industry and promoting research interaction in higher education, [and] ...promoting cooperation across agencies, sectors and jurisdictions' (Stocker, 1997: 48). A former Chief Scientist claimed 'the CRCs have by most accounts been the most successful scheme ever at linking end users and providers' (Batterham, 1997).

The continuing debate in Australia seems to revolve around several separate but related issues: (1) how broadly should we define 'industry and other end-users of research' in the context of the CRCs; (2) what is an appropriate balance between 'commercial' and 'public good' research within CRCs; and (3) should the program legitimately support research which primarily benefits only one company? The related question of (4) what organizational structure(s) are most appropriate for CRCs is raised only as a subsidiary issue.

The closely commercial element of the CRCs has been attacked both by those who see it as subsidy to industry and those who view it as detracting from the broader public interest goals

of the program. The influential Productivity Commission concludes 'the complete shift to industry-focused CRCs is inappropriate' (Productivity Commission, 2007: 371). It draws this conclusion solely because 'current cost-sharing arrangements do not appear to reflect the distribution of benefits from the program, with potentially large subsidies available to business partners'. This debate has played out before. The Mortimer Report of 1997 was opposed to any government innovation programs that favoured particular industry sectors or which produced 'private benefit' for firms. It recommended the termination of CRCs which fell into this category and retention of the CRC program only for 'public good' research (Review of Business Programs, 1997). At the same time Mortimer proposed targets for the universities and government laboratories to increase their spending on joint programs with industry. Our view was that the recommendations revealed an inadequate appreciation of industry-research collaboration and the complexity of cooperative relationships. The government rejected Mortimer's prescription.

The recent O'Kane review found that the program had become less attractive to researchers and users because of its complexity, inflexibility in governance and management and high transaction costs. Intellectual property issues in particular had become sticking point in partner negotiations, reflecting an expectation that each CRC was expected to commercialise the research itself. The review proposed that end-user take up of research would be a more appropriate goal (O'Kane, 2008).

Changes in the CRC program have reflected the broader debate on the nexus of science, innovation and society and the desirability of commercial returns from public research. Over the life of the program, its scope has broadened, accreting functions. The CRCs have survived the rearguard 'private good' economic rationalist arguments against their existence, but have bowed to compelling pressure to become more industry driven and to demonstrate paths for exploitation and application of their research. In short, the program has become more conservative and risk-averse. The current consensus is that the commercial emphasis has gone too far and the program needs to refocus on its original objectives.

### **3.2 Diverse missions are matched by diverse structures**

A strength of the CRCs is that they are 'proposal driven': proponents bid on the basis of their research programs, consortium of researchers and users, and contractual arrangements including structure. This has led to a spectrum of organizational structures ranging from relatively heterogeneous networks to 'joint ventures' narrowly focused on a particular technology or industry. While recognising the unique character of each CRC, Mercer and Stocker (1997: 5) recognised four categories of centres: 'commercially focussed with specific users'; commercial and public interest focus with industry development and new firm formation objectives; dispersed users: commercially focussed but generally more dispersed industry involvement and involvement of intermediaries; and primarily public interest focussed or underpinning sustainable resource use'. Howard Partners (2003) modified these groups to 'national benefits', 'collective industry benefits' and commercial benefits through 'new businesses'. These categories imply quite different ways of working especially with beneficiaries inside and outside the partnership. Mercer and Stocker found that outcomes such as 'appropriability by the private sector' were more significant for the 'specific users' group while the 'public interest' group valued wider 'acquisition and translation' of results.

We have observed different structures not just among the CRC partners, but in their links with the broader user community (Garrett-Jones & Turpin, 2002). CRCs in Mining and Energy for example appeared to be providing casual services to a large number of companies who were not their core or supporting members of the Centre. Medical CRCs, on the other hand, were strongly focussed on collaboration with their core partners. These findings support the notion above that CRCs can be segmented through their orientation towards different industrial and social 'clients'.

In 2001 we reviewed the performance framework used for evaluating individual CRCs and the program as a whole (Garrett-Jones & Turpin, 2002). A key question was the capacity of the framework to measure the achievements of a diverse range of individual CRCs and the program in aggregate. The considerable diversity in the missions of centres was reflected in their measurable research outputs. We asked 19 CRCs to nominate the performance measures that they had found most useful and informative in assessing research outcomes, technology transfer or application, education and training, and collaborative processes. We

found that particular outputs and outcomes have a different hierarchy of importance for different CRCs. Professional education activities, for example, ranged from courses aimed at surgeons who carry out cochlear implants to farmers intending to use hydrological optimisation software. Centres used quite different means of disseminating the written results of their research. For CRCs in the Agriculture, Environment and Medical fields, around half of their output was channelled through 'formal' publications, i.e. books and journal articles. CRCs in the fields of ICT, Mining, and Manufacturing relied on more 'informal' written outputs, i.e. published conference papers and unpublished reports for industry or other clients. Only one-third of their written output was in the form of journal articles. For Mining and Energy CRCs, unpublished industry reports comprised nearly half of their written output.

In the US Steenhuis & Gray (2005, 2006) have shown that the various models of university-industry collaborative centres are shaped by different drivers of strategy: IURCs by external groups, ERCs by creative leaders and STCs by management teams. Each of these elements is no doubt present in particular CRCs (Industry Commission, 1995: 861). By contrast the drift of the CRC program has been to impose a more uniform approach to organizational structure and to performance. In the process CRCs have 'emphasised end-users over research providers' (O'Kane, 2008: xii) and have become managed more as corporations than research networks. In short, they have become more directed and less cooperative.

Uniform governance fits poorly with the diverse missions and objectives of the CRCs, while erosion of collegiality sits uncomfortably with the expectations of the researchers. Much of the value that CRCs provide is intangible, through building collegial networks, the synergy of teams, their 'alumni' and the research culture imbued in their graduates (Garrett-Jones & Turpin, 2002). One of the benefits of the program we believe is in 'pushing the envelope' on organizational structures and networks of collaboration. A notable shortfall in the Australian research and debate concerns the effect of different management structures on the CRCs.

### **3.3 Researcher expectations on research culture and careers**

In 2004 we carried out a broadly-based survey of 370 academic and government participants in CRCs to assess their views on the benefits and problems of research collaboration in the centres (Garrett-Jones, Turpin, Burns, & Diment, 2005b; Garrett-Jones et al., 2009 in press; Turpin & Garrett-Jones, 2009 in press). Respondents strongly endorsed the benefits of participation in the CRCs. Benefits reported were largely intangible, notably the value of relations with researchers in their own field and in other disciplines. A large minority of respondents felt that CRC participation had enhanced their career prospects generally and improved the way they worked with industry partners. Our findings show that both academic and government researchers take a 'science based' view of the benefits of the CRCs: they value the centres in terms of the benefit for their own research productivity, teams, networks and careers. They assess partners on the strength of their scientific competence and commitment, not through contractual relationships. Personnel at all levels perceived their CRC experience as an important but transient step in their career trajectory, but some complained of a lack of career path post-CRC or a disjoint between their work in the CRC and partner organization – or 'role strain' (Boardman & Bozeman, 2007).

Cooperative thinking permeated the participants' expectations. The majority of respondents agreed on the importance of fully representative governance for the CRC while only a minority 'agreed/strongly agreed' that their views were adequately represented on the CRC governing boards or that they had enough influence over decisions by the CRC. Comments we received showed that respondents expected a strong voice in the strategy and running of the CRC and that they were unhappy when they were not consulted and involved. They were wary of high transaction costs and 'bureaucracy' that detracted from the scientific purpose of the centre.

We draw three conclusions from this work: (1) CRCs must recognise the knowledge resources (the scientific disciplines and careers of individual researchers) on which they are founded. Management which is overly directive or user-driven may be counterproductive; (2) management structures must be flexible enough to respond not just to the immediate research agenda but also the mediating role of CRCs between the broader objectives of the varied research partners. One model cannot possibly suit all centres; (3) for most participants, CRCs are a stepping stone. program management should celebrate the transitory nature of CRCs and promote the circulation and career transition of research personnel.

### 3.4 Dynamics of the innovation system

The Australian innovation system has changed markedly since 1990. Industry R&D has grown. Government research organizations like CSIRO are less dominant and universities more so. Experience in the management of collaborative R&D has developed at all levels. The two research councils have become the major funders of research, and greatly expanded their collaborative research programs, as has CSIRO with its Flagship collaboration fund. National centres have been established outside the CRC program in genomics, ICT, stem-cell research and defence. These dynamics are clearly reflected in the patterns of partner contributions to CRCs (O'Kane, 2008). The CRCs are no longer the 'only game in town' even for large scale cross-sector R&D. This implies the need for a 'whole of system' approach to future cooperative research structures and the research teams they comprise.

### 4. Conclusions

In our view, the mature CRC program now has a different role than when the program was launched. The primary *management* benefit of an integrated CRC program has been achieved: to inculcate the culture of structured collaborative research between public sector researchers, industry, public sector and non-profit end users. The program has given a huge coterie of researchers, administrators, policy makers and evaluators hands-on experience of the benefits and trials inherent in the structure, operation and evaluation of collaborative research. This was quite new in Australia in the late 1980s when the program was conceived on the basis of overseas models and local experience with large industry-collaborative grants. To this extent the CRC program has succeeded admirably.

We question the continuing value in 2009 of retaining a single, research collaboration scheme with such diverse constituencies and objectives and an increasingly conservative structure. The scale and high political profile of the program make it a target for frequent review and changes in government policy. The scope of the program has broadened, while the governance structures and performance measures have become more rigid and standardized. The expectations of researchers imply that the career paths within Centres need to be more seamlessly integrated with those of the partner organizations. Lastly, the Australian innovation system and environment for collaboration has changed markedly.

We propose that:

1. A greater variety of collaborative R&D institutional arrangements is required that takes into account the objectives of the collaboration. This may involve both a broader range of programs and a narrowing of the CRC program. The obvious solutions proposed over the years – a more 'sectoral' administration (e.g. bringing health and medical CRCs under the respective research council) and treating 'public good' and 'near-industry' centres differently – have some merit, but risk closing the interdisciplinary and inter-industry connections valuable in CRCs;
2. Arrangements for individual career progression and articulation should be introduced at the national level; One solution would be portable scholarships and fellowships that allow researchers to move in and out of CRCs, universities, government agencies and industry partners; and
3. The CRC program (or other government programs) should assist with 'progression and succession' arrangements for mature CRCs and their personnel, whether towards a more commercially oriented organization or to seed collaboration in related areas.

CRCs have indeed caused a structural shift in university-industry-government collaborative research in Australia. The O'Kane review has opened the debate on their future and deserves close consideration. We would like to see CRCs continue to lead the innovative organization of cross-sector research by concentrating on the non-obvious connections between research disciplines and in 'lateral innovation' between socioeconomic sectors. These may be speculative and more risky but are potentially more valuable for the advancement of research and society in today's challenging environment, and will hold continuing lessons for the structure and management of collaboration in research and its application.

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