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# Collaborating to a purpose

Review of the  
Cooperative Research Centres  
Program

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# **Collaborating to a purpose**

## **Review of the Cooperative Research Centres Program**

**July 2008**

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ISBN 978 0 642 72619 3

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Senator the Hon Kim Carr  
Minister for Innovation, Industry, Science and Research  
Parliament House  
Canberra ACT 2600

Dear Minister,

In January this year you commissioned a Review of the Cooperative Research Centres Program as part of the wider Review of the National Innovation System. The CRC Review is now completed and I have pleasure in sending this Report to you.

The CRC Program, introduced by the fourth Hawke Government in 1990, is an iconic program in the Australian innovation system that has been copied in other countries. The CRCs have produced important outcomes and changed the way Australians approach large-scale research cooperation focused on the needs of end-users. Over much of the life of the Program, it has been popular with end-users and research providers alike. However the Program is now 18 years old and the evolution in the objectives and selection criteria, along with changes in the external environment, have led to dissatisfaction with aspects of the Program, have restricted its potential in important sections of the Australian economy, and mean that its role as a driver of innovation in Australia is not as effective as it could be. The Program's many successes illustrate that there is still a need for a large-scale program bringing research providers and end-users together to solve major roadblock problems for industry and community, and in delivery of public goods and services. Accordingly the Review recommends a refreshed, refocused and modified program with a modest increase in total funding. With objectives more aligned to addressing clearly articulated major challenges, and more flexibility, the Program will attract a greater diversity of end-users and researchers alike. In consequence, the likelihood of rapid deployment by end-users of CRC research solutions – with an ultimate benefit, through spillovers, to the wider community – will be increased. The net result will be a significant contribution to a sustainable, community-oriented, productive, creative and prosperous Australia.

I would like to record my gratitude to my colleagues who worked with me on the Review – the members of the Collaboration Working Group of the NIS Review Panel, colleagues from that Panel and those who provided support to the Working Group.

I commend the report to you.

Yours sincerely,



Mary O'Kane

31 July 2008

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## Acronyms

ATO	Australian Taxation Office
ABS	Australian Bureau of Statistics
AIC	Australian Institute for Commercialisation
AMSRI	Australian Mineral Science Research Institute
ARC	Australian Research Council
CoE	ARC Centre of Excellence
CRC	Cooperative Research Centre
CRCA	Cooperative Research Centres Association
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CWG	Collaboration Working Group of NIS Review
DEEWR	Department of Education, Employment and Workplace Relations
DEWHA	Department of Environment, Water, Heritage and the Arts
ERA	The Excellence in Research for Australia Initiative
Go8	Group of Eight Universities
GRDC	Grains Research and Development Corporation
HdeH	Hawker de Havilland
IP	Intellectual Property
IT	Information Technology
LE	Large Enterprises (over 200 employees)
NCG	National Competitive Grant
NHMRC	National Health and Medical Research Council
NICTA	National ICT Australia
NIS	National Innovation System
PC	Productivity Commission
PFRA	Publicly funded research agency
PMSEIC	Prime Minister's Science, Engineering and Innovation Council
R&D	Research and development
RDC	Research and Development Corporation
ROI	Return on investment
SME	Small to medium enterprises (up to 200 employees)
SRC	ARC Special Research Centre

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## Recommendations

### Recommendation 1

#### 1.1: That

- i. a re-focused and modified CRC Program continue, and
- ii. the next evaluation recommend whether the Program continue in light of the modifications and the impact of changes arising from the Innovation White Paper.

#### 1.2: That

- i. funding be injected into the Program to allow for annual rounds to take place over the next five years;
- ii. there be a selection round at least once a year so that emerging market failure/creation and urgent public good issues can be addressed quickly; and
- iii. the Program encourage CRCs of varying lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), with funding up to a maximum of \$45M over the life of the Centre.

### Recommendation 2

#### That:

- i. the prime objective of the CRC Program be to provide support for pre-competitive or pre-applicative research ventures between end-users and researchers which tackle a clearly-articulated, major challenge for the end users addressing identified risk gaps such as:
  - a significant challenge in creation of a new industry area; or
  - a significant challenge in an existing industry sector where the risk involved in solving the challenge is too great for a single firm to tackle alone; or
  - a significant challenge in the provision of public goods and services; or
  - a significant challenge in an area of community or social benefit (and not restricted to an area represented by government portfolios).

The solution to the challenge should be innovative and of high impact and capable of being deployed rapidly by the end-users to good effect. Each CRC should be of high national benefit with significant spillovers.

- ii. a secondary aim of the Program be to encourage closer working ties between Australia's public-sector research organisations (universities and PFRA) and end-user groups and to encourage end-user-focused education, especially at the PhD level.

### Recommendation 3

#### 3.1: That the CRC Program guidelines be modified:

- i. to permit much greater flexibility than at present including in organisational structures, governance models, lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), membership arrangements, intellectual property arrangements and size of Commonwealth grant (up to a maximum of \$45M over the life of the Centre) but
- ii. that there be even higher requirements than at present on applicants to demonstrate why their proposed structure, membership arrangements, research plan, end-user absorptive capacity, leadership, key research people, outputs, likely impacts, performance metrics, governance, management, intellectual property arrangements, Centre lifespan and funding are appropriate to deliver a solution to the identified challenge and the fast and effective uptake of results by end-users.

**3.2:** That the legal agreement between the Commonwealth and the CRC be as simple as possible, with the recent practice continued of one party (the CRC itself or an agreed agent) signing on behalf of the CRC.

**3.3:** That the legal agreement include provisions requiring the CRC to be fully compliant with all relevant Commonwealth and State research integrity and ethics codes and guidelines and with

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all international treaties dealing with these matters. Records of all ethics applications and their current status must be kept up to date and be available at all times for inspection.

#### **Recommendation 4**

That a new program be established to assist industry and other end-user groups to undertake strategic analysis or innovation mapping projects and to establish collaborative ventures between end-users and researchers, including publicly funded research institutions. The priority is to support new collaborations in areas with little history of collaborative activity or a low research and development base, particularly service industries and those sectors populated by SMEs.

#### **Recommendation 5**

That participation in the CRC Program be encouraged, allowed or required as follows:

- i. SME and service industry involvement in CRCs be specifically encouraged;
- ii. CRCs addressing challenges across several service industries be encouraged
- iii. strong engagement with international research groups working on similar challenges be encouraged including, where appropriate, joint projects; and that funding of research undertaken overseas be allowed;
- iv. CRC applications in Humanities and Social Sciences fields be allowed and encouraged; and
- v. CRCs continue to be required to have at least one Australian university as a partner.

#### **Recommendation 6**

That the approach to funding of CRCs be redesigned in accord with the following:

- i. the share of public funding of any CRC be aligned to the level of likely induced social benefits;
- ii. CRC end-user applicants normally be expected to provide more than half the cash contribution towards the CRC;
- iii. in-kind contributions not be rated the same as cash during the selection and reporting processes, but treated as an important secondary factor. In turn, tied in-kind contributions (which should be declared at the time of application and in annual reporting) should not be rated as highly as untied in-kind contributions;
- iv. there be scope to modify the application of recommendations ii and iii to the advantage of end-user applicants where they are predominantly SMEs or from the community sector;
- v. universities and PFRAs be encouraged but not explicitly required to make cash or in-kind commitments to a CRC bid – but that, where they do make contributions, they be described in the same way as for other university/end-user collaborations (e.g. ARC Linkage Grants) and that they include details of program leaders and key researchers and their time commitments;
- vi. predominantly public good applications be scrutinised to see that they do indeed have the funding support of the ‘home’ Commonwealth and State portfolios or authorities; or, where this is not the case, that the reasons why are addressed as part of the application; and
- vii. there be no upper limit on postgraduate stipends offered within CRCs.

#### **Recommendation 7**

##### **7.1** That

- i. the CRC Program be administered at senior levels by secondees from across the NIS who have experience with similar programs as successful research end-users, researchers and research administrators.
- ii. CRC Committee members be chosen to ensure the committee has expertise in program design, delivery and review, and significant experience in successful joint ventures deploying research results.

**7.2** That the selection process involve layered peer review against detailed selection criteria which include the following:

- the risk being addressed (how significant is the problem? What is the current state-of-the-art worldwide in addressing this problem?)
- the quality of the research approach and plan and how it will address the identified risk

- the capabilities of the participants (how well do the proposed end-users connect with the identified problem, and how highly regarded in their field are the proposed researchers?)
- the quality of the leadership and the research and management teams
- the quality of the education program
- the proposed success/progress metrics
- how the end-user partners will deploy the research findings and gain advantage from the Commonwealth investment
- the expected wider spillover benefits and how these will be taken up by parties outside the collaboration
- the genuineness of the joint venture and alignment of interests (i.e. checking that it is not 'hollow collaboration'), and
- the suitability of the proposed accountability and governance arrangements including the management of the joint venture.

### 7.3 That

- i. CRC applications be submitted using a two-stage process. Applicants would initially make the case in a written application(s) and, if shortlisted, following peer review, would be given the chance to augment this at interview;
- ii. the CRC Committee establish disciplinary-based standing committees drawing on expertise in the ARC and NHMRC to manage the peer-review processes associated with the first-stage culling, and second-stage ranking. These committees should use a common formal process which should include giving the applicant CRC the chance to comment on assessors' comments in writing;
- iii. the CRC Committee consult with the ARC and NHMRC to develop a joint database of assessors to do the rigorous assessing of CRC applications for consideration by the standing committees;
- iv. the standing committees rank proposals assigned to them on all criteria after obtaining sufficient peer assessments, and then overall, and make recommendations to the CRC Committee; and
- v. the CRC Committee consider all the input and recommend a final list to the Minister.

**7.4:** That a common core of evaluation metrics be developed that would apply across all CRCs and would allow for cross-comparison between them. These should include, at minimum, metrics on research quality, end-user uptake, international connections for national benefit, and researcher education. As well as reporting on the core evaluation metrics, it is recommended that CRCs, in their annual report, report on measures specific to their CRC and agreed at the time the CRC is awarded.

**7.5:** That annual reports be examined closely for early warning signs of difficulty.

**7.6:** That a major hard-nosed review of each CRC using a common evaluation framework take place at the end of each 3 years – or more frequently if there are early warning signs of failure – of the life of a CRC, with a final review as it is finishing; and that it be an explicit condition of funding that termination be an option if the review's findings are adverse.

**7.7:** That the CRC Committee establish a Review Sub-committee to

- i. oversee the review process;
- ii. propose the composition of the initial and subsequent review panels to the CRC Committee for approval. The same review panel should be used for all CRCs in a field of application in order to ensure cross comparison. Each review panel to be chaired by a Sub-committee member;
- iii. consider feedback from the review panels;
- iv. prepare a report for the CRC Committee on each review round including a list of CRCs reviewed, ranked by success to date; and
- v. propose which CRCs continue to receive Commonwealth funding under the Program and which should no longer be funded.

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## **Recommendation 8**

**8.1:** That the CRC Program build close policy and operational links with other collaborative research programs in the National Innovation System and that it articulate well with the CSIRO National Research Flagships Program, ARC Linkage Program and the NHMRC Partnerships for Better Health Program. While the CRC Program should focus more on funding large end-user-driven collaborative pre-competitive research, the Linkage Program should continue to fund simpler end-user/university partnerships. In line with the move to larger Linkage grants, these programs should complement the CRC Program by supporting long term-basic/strategic research with smaller, shorter and more flexible arrangements between groups of firms either independently or in conjunction with universities and public sector research agencies. The administrators of these programs (and related State programs) should meet regularly to discuss applications that might be eligible to either scheme.

**8.2:** That

- i. a common core of broad evaluation measures be developed that would apply across all Government innovation funding programs (especially programs involving collaboration) and their projects;
- ii. common application and review forms/processes be used as far as possible across all innovation funding schemes, especially schemes involving collaboration (including Federal & State schemes); and
- iii. a much improved capacity to review innovation funding programs (especially schemes involving collaboration) be developed along with a robust capacity to cease funding weaker projects. Sometimes international review mechanisms are needed.

**8.3:** That the ARC Centre of Excellence Program be enlarged and become annual and that it encourage applications from innovative research concentrations that have proved themselves producers of high quality and high impact research through programs such as the CRC Program (but also through multi-partner, collaborative ARC Discovery and Linkage grants).

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## Executive summary

### Introduction

The Cooperative Research Centres Program was established by the fourth Hawke Government in 1990, having been designed by Professor Ralph Slatyer, the then Chief Scientist, primarily to encourage collaboration in research and development between the private sector and the public sector research bodies but also to address research concentration for world-class teams and preparing PhD graduates for non-academic careers.

To date there have been 10 selection rounds resulting in 168 CRCs over the life of the Program (102 if renewals and new-from-existing are not counted separately). In 2007-08 there were 58 CRCs. Of these, 25 were in their 1<sup>st</sup> term, 16 in their 2<sup>nd</sup> term and 17 in their 3<sup>rd</sup> term. Nine CRCs reached the end of their funding term in June 2008, hence there are 49 CRCs receiving funding in 2008-09. The first selection round resulted in 20 CRCs; the last round in 2006 resulted in 3 new CRCs, 7 new-from-existing CRCs and 4 extensions.

The total investment by the Commonwealth is of the order of \$3 billion, with almost \$9 billion (in kind and in cash – tied and untied) leveraged from participants - including approximately \$2.9 billion from universities; \$2.3 billion from industry; \$1.6 billion from government end-users; and \$1.1 billion from CSIRO.

Since its inception, the Program has delivered significant, identifiable economic and social benefits, particularly through end-user application of research.

As a discrete part of the broader review of the National Innovation System (NIS), the Minister for Innovation, Industry, Science and Research, Senator the Hon Kim Carr, announced a Review of the Cooperative Research Centres Program on 22 January 2008. The Chair of the Review was Professor Mary O’Kane; she was supported by the Collaboration Working Group (CWG) of the National Innovation System (NIS) Review.

The Review looked at the general issue of collaboration and its place within the NIS; and at how the CRC Program fits with other programs in the NIS in contributing to national productivity and social good through collaboration. The Review took note of some consistent themes coming through the consultations and submissions and sought to understand these in the light of the CRC Program’s evolution, as reflected in data on the Program and changes to the selection criteria. It also considered how changes in funding and incentive systems for CRC participants, especially the public-sector research providers, have affected the way these participants have interacted with the Program. In line with its terms of reference, the CWG also drew on the Productivity Commission’s Research Report of 9 March 2007, *Public Support for Science and Innovation*.

### Why collaborate?

There are many benefits to be had from bringing groups of researchers and end-users together. These include the achievement of critical mass; overcoming fragmentation caused by distance and a smaller resource base; bringing together different perspectives, experience, skills and knowledge; breaking down specialist silos and restrictive organisational boundaries and fostering cross-disciplinary interactions; encouraging skills and knowledge transfer; promoting mutual understandings; and managing risks.

These benefits of collaboration underpin the CRC Program. However, the Review emphasises that collaboration should not be an end in itself but a means to generate productive and innovative outcomes for both the collaborators and the taxpayers whose funds are invested in the Program.

Governments at all levels have been active in encouraging collaboration in the NIS. From the 1980s onwards there has been an increasing understanding of the need for Commonwealth Government support for collaboration to tackle high-risk projects, and a variety of programs has been introduced, including CSIRO National Research Flagships, ARC Centres of Excellence, ARC Linkage Grants, and, very recently, NHMRC Partnership for Better Health Grants. These have been complemented by a range of State government programs.

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A recent ABS study found that innovative firms show a strong tendency to collaborate – but with other firms. Of those firms which collaborate, only about 3% do so with government organisations and about 2% with higher education research organisations<sup>1</sup>. Australia still needs programs such as the CRC Program to bridge the gap between our strong public-sector research capacity and its potential use by innovative Australian firms.

While about 570 Australian firms have participated in CRCs, funding even in a large program such as this is limited, and consequently the firms participating represent only a small fraction of all Australian firms. However the CRC Program has had a whole-industry impact in CRCs where there is strong drive from a strong industry intermediary. For example, large numbers of agricultural businesses have benefited from rural Research and Development Corporations' involvement in CRCs; and mining businesses have benefited from the broker role AMIRA International has played in mining CRCs. The Review suggests that in future the Program encourage more CRCs with impact across broad groupings of end-users.

### **The CRC Program has changed focus over time**

Analysis of the Program's objectives, selection criteria and guidelines reveals that the CRC Program has changed considerably since its inception. While cooperative research is still the underlying *raison d'être* for the Program, the early ideals of enhancing and expanding the nation's overall scientific and technological research capability to support broadly stated national objectives have been replaced by a heavy emphasis on supporting end-user driven research and research capable of producing commercial return. While the early guidelines looked for a balance between strategic pre-competitive research and shorter-term research leading directly to application or commercialisation, the later guidelines placed an absolute focus on commercialisation/utilisation of outcomes. This has been emphasised by more stringent requirements to demonstrate their IP management and commercialisation 'vehicles', with clear milestones and 'paths to adoption'.

The early rounds required that the research itself be of high quality, but this has been less prominent in later rounds. While graduate education and training was a specified objective for the first years, specific reference to this was dropped from the objectives and the selection criteria in 2004 (though CRCs were still required to have a PhD program). The early rounds recognised the cooperative aspect of CRCs, but the later rounds emphasised end-users over research providers, to the point of requiring that research providers not be in the majority on governing boards. Early CRCs were permitted considerable flexibility about their management and governance arrangements, so long as there were clear lines of responsibility and accountability linking the participants, but there has been a steadily increasing specification of requirements, and CRCs in the last two rounds have been required to be incorporated with independent chairs and the full governance strictures of corporate entities.

These trends are consistent with the drive over the last 20 years to derive financial returns from commercialisation of intellectual property arising from publicly supported research – the current program objective and guidelines provide a framework for commercialisation of research from CRCs. However the Review notes the findings of two economic-impact studies<sup>2</sup> of the CRC Program which have argued that while the economic impact of the Program has been considerable, it has been primarily through end-user application of research rather than direct commercialisation.

The Productivity Commission argued that the emphasis on commercial outcomes was less defensible from an economic efficiency perspective and more likely to result in research collaborations of a type that a firm or industry collective would undertake anyway. In any event, CRCs typically appear not to have the know-how and resources to be particularly good at commercialisation (with singular exceptions).

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<sup>1</sup> ABS 8158.0 Innovation in Australian Business 2005

<sup>2</sup> Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia – Delivering Benefits for Australia*, A report for the Cooperative Research Centres Association Inc, December 2005; and Insight Economics 2006, *Economic Impact Study of the CRC Programme*, Prepared for the Department of Education, Science and Training, Insight Economics, Melbourne.



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The Productivity Commission recommended, and this Review agrees, that a greater emphasis be placed on translating research outputs into not just economic, but also social and environmental, benefits. The latter two objectives can be achieved by re-instating public good as a CRC objective, a commitment made in the current Government's election promises and which the Review supports.

### **Concerns about the CRC Program**

Through most of its life the CRC Program has been popular with participants. However the consultations and submissions to this Review and submissions to the 2007 Productivity Commission Report indicated that the Program is less attractive than formerly to some important participant groups, most notably CSIRO and the research-intensive universities, but also some significant end-users. The concept of end-users and research providers working together on research to produce productive outcomes still draws strong support – the problems seem to centre on the collaboration vehicle itself, and what is allowed and encouraged explicitly and implicitly in the Program.

The need for a more flexible Program, and the complexity and cost of CRC governance arrangements, were frequently raised in submissions and consultations about the CRC Program by end-users and research providers alike. Indeed, it was consistently raised as one of the 'dark matters' of the current innovation system during the consultations. The high costs of bidding for CRCs, the transaction costs of involvement with them, the lack of flexibility in suiting governance and management to the needs of the partners, and the lack of an adequate return on investment for partners, especially when the CRC is incorporated, also drew comment.

Intellectual property (IP) arrangements drew a lot of comment. Despite detailed coverage of this matter in the legal agreements for CRCs, early clarity seems to be lacking. Continuing unrealistic expectations by universities and government research bodies that the IP within a CRC will generate a major financial flow to their institutions underlies many of the cited difficulties in reaching agreement on IP arrangements. This is exacerbated by the belief – encouraged by the application process – that the CRC itself will be the commercialiser of the IP resident in the CRC. Agreements would be easier to negotiate if it were accepted that the industrial/end-user partners are the logical developers of the IP, with the question of fair and reasonable returns from the industrial partner to the research providers and their institutions a matter to be negotiated, in general terms, at the commencement of the CRC.

The Review agrees that

*collaborative innovation and the transfer of ideas are often impeded and curtailed by problems and delays arising out of the negotiation and formalisation of agreements for collaborative research.*<sup>3</sup>

### **Comments against evaluation principles**

The Review was specifically asked to evaluate the CRC Program against principles used for new policy proposals and reviews. The first goes to *Appropriateness*. The Review finds the Program primarily addresses a gap left by the market directly, and also indirectly, through the influence it has had on the design of other programs. In the past, when public good was one of the Program's objectives, it has also sponsored some innovative collaborations addressing social inequity. The Review also finds that the CRC Program is appropriate as a national program, pulling together research expertise from across the country often with active assistance from State Governments.

On the *effectiveness* of the Program – whether it represents value for taxpayer funds, and whether it has achieved its stated objectives – the Review has taken note of two recent studies<sup>4</sup> and also the Productivity Commission's report. While the Review is cautious about placing too much credence on the precise figures produced by the economic models used, these studies

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<sup>3</sup> Fitzgerald and Austin, law academics who work with the Open Access to Knowledge (OAK) Law Project at Queensland University of Technology, in submission to NIS Review, 428A-Fitzgerald & Austin, p.13.

<sup>4</sup> Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia – Delivering Benefits for Australia*, A report for the Cooperative Research Centres Association Inc, December 2005; and Insight Economics 2006, *Economic Impact Study of the CRC Programme*, Prepared for the Department of Education, Science and Training, Insight Economics, Melbourne.



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give confidence that the CRC Program does provide a positive return on taxpayers' funds invested.

The current CRC Program objective is:

*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.*

It is hard to produce a precise quantitative estimate of how much the CRCs have enhanced Australia's growth, especially net economic growth. High levels of *commercialisation* have not occurred but there is evidence that benefits have come from industry *application* of CRC research. Like the Productivity Commission, but for additional reasons, this Review does not consider the current Program objective to be appropriate. This issue is addressed at Recommendation 2.

In looking at the *efficiency* of delivery of the CRC Program, the Review was cognisant of the oft-stated complaints about the high costs associated with planning, bidding for and establishing new CRCs, and the ongoing governance and transaction costs. The Program requires more flexibility; and improved efficiency in the selection and review process (see Recommendations 3 and 7).

On *integration* – whether government agencies are working together to deliver on measure objectives within clearly defined lines of responsibility – greater integration with agencies offering related programs would benefit the Program, in both program-design quality and operating efficiencies, and would provide better articulation between programs that form a 'spectrum' in the NIS.

The CRC Program has a formidable *performance assessment* system of reporting and reviewing including annual reports; a major third-year review; and a requirement to lodge a Commercialisation and Utilisation Plan. The Review suggests that the system might be excessive rather than robust, and that its selection procedures are inappropriately risk averse. This issue is addressed in Recommendation 7.

The Review finds that the CRC Program does *strategically align* with the government's long-term policy priorities for innovation driving economic growth.

## **The future**

The CRC Program needs to work for all those funding it and participating in it. It needs to be an appropriate, efficient and effective investment of government funds. It needs to produce research for end-users that allows rapid breakthrough business transformation. For research providers, it needs to attract and stimulate their very best researchers. For all parties the organisational and funding arrangements need to work smoothly while consistent with prudential requirements.

The feedback from consultations, workshops and submissions was overall remarkably consistent about current concerns with the CRC Program. No one suggested that the Commonwealth should stop providing incentives for research collaborations between researchers from the universities and publicly funded research agencies on the one hand and industry and public and community sector users on the other. The biggest issue was on the degree of change required.

## **Continue the CRC Program with additional funding**

The Review finds there is still a need for a program supporting big, end-user-inspired and driven, risk-addressing research projects directed at significant national issues (and outcomes) across Australia's innovation system. The benefits of the CRC Program warrant continued investment in it, provided its objectives are re-focused, the problematic aspects raised in submissions and consultations addressed, and its success in meeting the new objectives regularly reviewed.

Unless some extra funding is injected into the Program the next round will be able to fund only a small number of centres. This could exacerbate the unease with aspects of the Program. In particular the next round could see a 'spike' in applications as many existing CRCs are likely to apply to be new CRCs.

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If CRC funding is to be linked directly and specifically to solving major problems of market failure/creation and public good, more frequent opportunities to submit applications for CRCs are desirable, and an annual round is proposed.

**Recommendation 1**

**1.1:** That

- i. a re-focused and modified CRC Program continue, and
- ii. the next evaluation recommend whether the Program continue in light of the modifications and the impact of changes arising from the Innovation White Paper.

**1.2:** That

- i. funding be injected into the Program to allow for annual rounds to take place over the next five years;
- ii. there be a selection round at least once a year so that emerging market failure/creation and urgent public good issues can be addressed quickly; and
- iii. the Program encourage CRCs of varying lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), with funding up to a maximum of \$45M over the life of the Centre.

**Change the Program objectives - collaborating to a purpose; end-user take up of CRC research**

The emphasis of CRC research must be directed to end-user uptake rather than commercialisation by the CRC itself. This requires changing the objectives to focus very specifically on research collaborations aimed at ameliorating a clearly-identified risk, such as

- a significant challenge in creation of a new industry area; or
- a significant challenge in an existing industry sector where the risk involved in solving the challenge is too great for a single firm to tackle alone; or
- a significant challenge in the provision of public goods and services; or
- a significant challenge in an area of community or social benefit (and not restricted to an area represented by government portfolios).

The solution to the challenge would provide a significant advantage – not necessarily commercial – for CRC end-users, preferably with significant spillovers. Without an exact challenge to be met, it is difficult to decide whether the research is potentially valuable: either to end-users, or to the national benefit.

CRCs would be put together to carry out research to address the CRC's core challenge, pass the findings on to end-users as efficiently as possible (including through provision of PhD graduates who have been trained through the CRC), then wind up (either winding up the research program for which funding was received or wind up altogether). The focus of the research should be at the pre-competitive or, in the case of public-good CRCs, pre-applicative stage.

This emphasis on a single purpose will also help avoid the tendency by CRCs to become an end in themselves.

**Recommendation 2:** That

- i. the prime objective of the CRC Program be to provide support for pre-competitive or pre-applicative research ventures between end-users and researchers which tackle a clearly-articulated, major challenge for the end users addressing identified risk gaps such as:

- a significant challenge in creation of a new industry area; or
- a significant challenge in an existing industry sector where the risk involved in solving the challenge is too great for a single firm to tackle alone; or
- a significant challenge in the provision of public goods and services; or
- a significant challenge in an area of community or social benefit (and not restricted to an area represented by government portfolios).

The solution to the challenge should be innovative and of high impact and capable of being deployed rapidly by the end-users to good effect. Each CRC should be of high national benefit with significant spillovers.

- ii. a secondary aim of the Program be to encourage closer working ties between Australia's

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public-sector research organisations (universities and PFRAAs) and end-user groups and to encourage end-user-focused education, especially at the PhD level.

### **CRC organisational arrangements need to be fit for purpose**

Solving big challenges requires organisational arrangements fit for purpose. The joint venturers in a CRC need to be very clear on what they are attempting to do; how they intend to go about doing it, and what governance, management, reporting and end-user take up arrangements for CRC outputs are most likely to work for them. And to attract funding, they need to be able to justify their proposals. The Program needs to be flexible enough to accommodate this.

CRCs do not need to be incorporated to be successful. Of course, issues of leadership and management, accountability and responsibility, must be addressed early in the collaboration; but there are many different models for what are fundamentally joint ventures, and the collaborators should be free to choose a model which is most likely to ensure the aims and purpose of the collaboration are achieved. This extends to representation on the Board (if there is one), which should be linked to the input of resources into the CRC and the participants' wishes, rather than the present arbitrary requirement that end-users and/or independents hold a majority of Board positions.

Flexibility of lifespan and membership arrangements were frequently raised as problems even though they are technically allowed under the guidelines. The general period should be 4-7 years, with occasional opportunities for shorter and longer terms if the situation warrants; and membership arrangements should permit partners to join late and exit early.

Allowing more flexible arrangements means that the initial case has to be well made. Applicants must demonstrate how the proposed research and education program will address the identified challenge and then how the end-user partners will deploy the research findings and gain advantage from the Commonwealth investment with spillovers.

The Legal Agreement between the Commonwealth and the CRC needs to be as simple as possible, with one party (the CRC itself or an agreed agent) signing on behalf of the CRC. The Agreement also needs to formally require compliance with both research ethics and research integrity codes and guidelines.

### **Recommendation 3**

**3.1:** That the CRC Program guidelines be modified:

- i. to permit much greater flexibility than at present including in organisational structures, governance models, lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), membership arrangements, intellectual property arrangements and size of Commonwealth grant (up to a maximum of \$45M over the life of the Centre) but
- ii. that there be even higher requirements than at present on applicants to demonstrate why their proposed structure, membership arrangements, research plan, end-user absorptive capacity, leadership, key research people, outputs, likely impacts, performance metrics, governance, management, intellectual property arrangements, Centre lifespan and funding are appropriate to deliver a solution to the identified challenge and the fast and effective uptake of results by end-users.

**3.2:** That the legal agreement between the Commonwealth and the CRC be as simple as possible, with the recent practice continued of one party (the CRC itself or an agreed agent) signing on behalf of the CRC.

**3.3:** That the legal agreement include provisions requiring the CRC to be fully compliant with all relevant Commonwealth and State research integrity and ethics codes and guidelines and with all international treaties dealing with these matters. Records of all ethics applications and their current status must be kept up to date and be available at all times for inspection.

### **Helping potential participants work out what they need to do - an auxiliary program**

Public-sector partners are experienced at submitting big grant applications but industry (especially service industries and those sectors populated by SMEs) and community groups often find it harder. And they find it hard to locate the most appropriate research partners.

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The introduction of an auxiliary program to assist such groups to explore shared problems, formulate shared approaches to solving them and establish the details of collaborations – collaborations that might in time be the basis for a CRC bid – would address this issue. Under the program, potential applicant groups would:

- have an opportunity to explore, frame and experiment with ideas, challenges, problems and opportunities affecting their sectors
- get the definition of their problems right and work how to go about solving them
- identify appropriate research partners and end-users
- work out the formal arrangements for working together including IP, management and governance arrangements
- find out who is doing similar work around the world and decide whether to seek them out as international partners, or direct their own focus into other areas
- work out the skilled labour force requirements.

The auxiliary program would complement the proposed Industry Innovation Councils which are to be introduced by the Commonwealth Government later in 2008 and will operate in 'key sectors' to support the Enterprise Connect network.<sup>5</sup>

#### **Recommendation 4**

That a new program be established to assist industry and other end-user groups to undertake strategic analysis or innovation mapping projects and to establish collaborative ventures between end-users and researchers, including publicly funded research institutions. The priority is to support new collaborations in areas with little history of collaborative activity or a low research and development base, particularly service industries and those sectors populated by SMEs.

#### **Promote to the right participants**

A wider diversity of participants needs to be encouraged into CRCs. This includes SMEs, which have long been identified as a vital part of the Australian economy; services industries, which underpin Australia's domestic economy; and the humanities and social sciences, which are particularly important to the services industries, but also have an increasing role in the multidisciplinary approach which is required to solve most pressing real-world problems.

Because education – especially research training – is essential to developing Australia's innovation capacity, and because universities are significant research providers, it is important that every CRC application continue to secure a commitment in the bid from at least one Australian university. The university must guarantee to provide supervision for PhD students associated with the Centre, in return for CRC funding of the supervision if needed; and be continually vigilant in ensuring the research training experience for students is comprehensive and in line with industry and educational needs.

Involvement on the international stage is also vital if Australia's innovation system is to develop to its full capacity. Strong engagement with international research groups working on similar challenges to those of an Australian CRC must be encouraged including, where appropriate, joint projects.

#### **Recommendation 5**

That participation in the CRC Program be encouraged, allowed or required as follows:

- i. SME and service industry involvement in CRCs be specifically encouraged;
- ii. CRCs addressing challenges across several service industries be encouraged
- iii. strong engagement with international research groups working on similar challenges be encouraged including, where appropriate, joint projects; and that funding of research undertaken overseas be allowed;
- iv. CRC applications in Humanities and Social Sciences fields be allowed and encouraged; and
- v. CRCs continue to be required to have at least one Australian university as a partner.

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<sup>5</sup> <http://www.ato.gov.au/budget/2008-09/content/bp2/html/expense-20.htm>

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## Re-design the funding arrangements

The funding arrangements for CRCs need to work in a way that ensures that the Commonwealth's investment in a CRC is appropriate, and that the funding rules encourage participation in the Program by both end-users (especially from SMEs and the services sector) and research providers.

Contributions to CRCs can be made in different ways, but in the past the balance between the Commonwealth, research-providers and end-users has not been the most effective. Requiring end-users to provide substantially higher cash funding to maximise the value of the Commonwealth's contribution would be in line with international best practice for major centres. However, for SMEs, which are typically less cashed up to support the quality of research required, a continued ability to commit through in-kind contributions is warranted.

Universities (and, to a lesser extent, other research providers) face a continual challenge in finding the funding required to undertake their research activities. This, plus the changes to CRC governance which restricted their representation on CRC boards, has led to a perverse situation. Some research providers have resorted to side deals with potential CRCs, making their contributions conditional on being guaranteed a return in research funding several times greater than their contributions. In other words, for many research providers CRCs have ceased being eagerly sought-after collaborations and become rather circumscribed research granting bodies. The complexities and ill-will surrounding these deals are, in turn, resulting in leading researchers abandoning the CRC Program. The Review recommends that the CRC Program not insist on research provider contributions but encourage such contributions and, in line with this, adopt the system currently used in the ARC Linkage Grants for universities (and other research providers) to specify what they are contributing to each CRC.

For public good CRCs, it is important that applications provide evidence that relevant Government agencies and portfolios, whether State or Commonwealth, strongly support the CRC application.

### Recommendation 6

That the approach to funding of CRCs be redesigned in accord with the following:

- i. the share of public funding of any CRC be aligned to the level of likely induced social benefits;
- ii. CRC end-user applicants normally be expected to provide more than half the cash contribution towards the CRC;
- iii. in-kind contributions not be rated the same as cash during the selection and reporting processes, but treated as an important secondary factor. In turn, tied in-kind contributions (which should be declared at the time of application and in annual reporting) should not rate as highly as untied in-kind contributions;
- iv. there be scope to modify the application of recommendations ii and iii to the advantage of end-user applicants where they are predominantly SMEs or from the community sector;
- v. universities and PFRAs be encouraged but not explicitly required to make cash or in-kind commitments to a CRC bid – but that, where they do make contributions, they be described in the same way as for other university/end-user collaborations (e.g. ARC Linkage Grants) and that they include details of program leaders and key researchers and their time commitments;
- vi. predominantly public good applications be scrutinised to see that they do indeed have the funding support of the 'home' Commonwealth and State portfolios or authorities; or, where this is not the case, that the reasons why are addressed as part of the application; and
- vii. there be no upper limit on postgraduate stipends offered within CRCs.

## Encouraging fleet and flexible CRCs requires top quality program design and management

The Review recommendations are aimed at ensuring a much greater diversity of CRCs with organisational arrangements designed to maximise the chances for each particular CRC to be as effective as possible. Encouraging this diversity and instituting the increased flexibility needed



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will require program managers who are experienced in end-use-focused research, research management, and program design and management. The Review recommends such expertise be co-opted into the Program from across the NIS.

Rigorous assessment against criteria aligned to the Program objectives is essential. Under the modified CRC Program proposed, changes to the current selection criteria are required and selection should be fundamentally based, in line with best practice for grants as large as this, on layered peer review.

Successful review mechanisms are one of the keys to running a successful research funding program. They help maintain rigour and focus, and ensure accountability. Hard-nosed review using a core of common measures across all CRCs (and across other collaboration programs) should be encouraged. However, review mechanisms are not useful if they have no consequences. A level of failure should be expected and accepted as the CRC Program will cover areas where there are risk gaps. There should be an expectation that a proportion of CRCs will lose funding at each review round.

### **Recommendation 7**

#### **7.1 That**

- i. the CRC Program be administered at senior levels by secondees from across the NIS who have experience with similar programs as successful research end-users, researchers and research administrators.
- ii. CRC Committee members be chosen to ensure the committee has expertise in program design, delivery and review, and significant experience in successful joint ventures deploying research results.

#### **7.2 That the selection process involve layered peer review against detailed selection criteria which include the following:**

- the risk being addressed (how significant is the problem? What is the current state-of-the-art worldwide in addressing this problem?)
- the quality of the research approach and plan and how it will address the identified risk
- the capabilities of the participants (how well do the proposed end-users connect with the identified problem, and how highly regarded in their field are the proposed researchers?)
- the quality of the leadership and the research and management teams
- the quality of the education program
- the proposed success/progress metrics
- how the end-user partners will deploy the research findings and gain advantage from the Commonwealth investment
- the expected wider spillover benefits and how these will be taken up by parties outside the collaboration
- the genuineness of the joint venture and alignment of interests (i.e. checking that it is not 'hollow collaboration'), and
- the suitability of the proposed accountability and governance arrangements including the management of the joint venture.

#### **7.3 That**

- i. CRC applications be submitted using a two-stage process. Applicants would initially make the case in a written application(s) and, if shortlisted, following peer review, would be given the chance to augment this at interview;
- ii. the CRC Committee establish disciplinary-based standing committees drawing on expertise in the ARC and NHMRC to manage the peer-review processes associated with the first-stage culling, and second-stage ranking. These committees should use a common formal process which should include giving the applicant CRC the chance to comment on assessors' comments in writing;
- iii. the CRC Committee consult with the ARC and NHMRC to develop a joint database of assessors to do the rigorous assessing of CRC applications for consideration by the standing committees;
- iv. the standing committees rank proposals assigned to them on all criteria after obtaining

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- sufficient peer assessments, and then overall, and make recommendations to the CRC Committee; and
- v. the CRC Committee consider all the input and recommend a final list to the Minister.

**7.4:** That a common core of evaluation metrics be developed that would apply across all CRCs and would allow for cross-comparison between them. These should include, at minimum, metrics on research quality, end-user uptake, international connections for national benefit, and researcher education. As well as reporting on the core evaluation metrics, it is recommended that CRCs, in their annual report, report on measures specific to their CRC and agreed at the time the CRC is awarded.

**7.5:** That annual reports be examined closely for early warning signs of difficulty.

**7.6:** That a major hard-nosed review of each CRC using a common evaluation framework take place at the end of each 3 years – or more frequently if there are early warning signs of failure – of the life of a CRC, with a final review as it is finishing; and that it be an explicit condition of funding that termination be an option if the review's findings are adverse.

**7.7:** That the CRC Committee establish a Review Sub-committee to

- i. oversee the review process;
- ii. propose the composition of the initial and subsequent review panels to the CRC Committee for approval. The same review panel should be used for all CRCs in a field of application in order to ensure cross comparison. Each review panel to be chaired by a Sub-committee member;
- iii. consider feedback from the review panels;
- iv. prepare a report for the CRC Committee on each review round including a list of CRCs reviewed, ranked by success to date; and
- v. propose which CRCs continue to receive Commonwealth funding under the Program and which should no longer be funded.

### **Improve articulation with other programs in the NIS**

The Review recommends ongoing and effective articulation and cooperation between the CRC Program and other funding programs in the NIS, especially with CSIRO Flagships, ARC Linkage Grants and NHMRC Partnership for Better Health Grants.

### **Recommendation 8**

**8.1:** That the CRC Program build close policy and operational links with other collaborative research programs in the National Innovation System and that it articulate well with the CSIRO National Research Flagships Program, ARC Linkage Program and the NHMRC Partnerships for Better Health Program. While the CRC Program should focus more on funding large end-user-driven collaborative pre-competitive research, the Linkage Program should continue to fund simpler end-user/university partnerships. In line with the move to larger Linkage grants, these programs should complement the CRC Program by supporting long term-basic/strategic research with smaller, shorter and more flexible arrangements between groups of firms either independently or in conjunction with universities and public sector research agencies. The administrators of these programs (and related State programs) should meet regularly to discuss applications that might be eligible to either scheme.

**8.2:** That

- i. a common core of broad evaluation measures be developed that would apply across all Government innovation funding programs (especially programs involving collaboration) and their projects;
- ii. common application and review forms/processes be used as far as possible across all innovation funding schemes, especially schemes involving collaboration (including Federal & State schemes); and
- iii. a much improved capacity to review innovation funding programs (especially schemes involving collaboration) be developed along with a robust capacity to cease funding weaker projects. Sometimes international review mechanisms are needed.

**8.3:** That the ARC Centre of Excellence Program be enlarged and become annual and that it encourage applications from innovative research concentrations that have proved themselves

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producers of high quality and high impact research through programs such as the CRC Program (but also through multi-partner, collaborative ARC Discovery and Linkage grants).

## **Conclusion**

The Review expects implementation of its recommendations to result in many more end-user industries and service providers being involved in CRCs. End-users will come from a wider range of industries and services than have so far participated in CRCs. More of them will be SMEs. Universities and PFRAAs will be excited about the opportunities for quality research with potential national and international impact and will be enthusiastic participants. They will partner with end-users as joint venturers in CRCs to tackle big problems that affect a whole industry or sector or community. The solutions will be rapidly deployed by end-users to the benefit of end-users and, through spillovers, the wider community.

CRCs will be diverse in structure, size and longevity. Some will be quite small; others large. Some will be short term; others for a longer term of up to 10 years. Some will incorporate; others will choose different management and governance structures that suit their purpose. Most will have international connections so that Australia can be informed by, and inform, the rest of the world. Employers will compete for researchers and PhD graduates from CRCs. There will be growth in related programs, including ARC Linkages, to develop and nurture collaborative activity. When the problem is solved, participants will move on to other forms of collaboration to solve other problems. Success on all these fronts will be a measure of the relevance and importance of the CRC Program to Australia's innovation system. Success will also guarantee a sound return on the Commonwealth's investment. And success will contribute to a sustainable, community-oriented, productive, creative and prosperous Australia.



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## 1 Introduction/process

The Minister for Innovation, Industry, Science and Research, Senator the Hon. Kim Carr, announced the Review of the Cooperative Research Centres Program on 22 January 2008, as a discrete part of the broader review of the National Innovation System (NIS). He stated that

*The CRC review highlights the Government's commitment to science and innovation and will identify areas to further promote and encourage investment and collaboration between research and industry. The review will be comprehensive and will consider all aspects of the CRC Program. It will examine the overall strategic direction of CRCs, looking at the full range of issues, including governance and program design issues, the level and length of funding needed to support the program's objectives, as well as its overall scope and effectiveness.*<sup>6</sup>

The Chair of the Review was supported by the Collaboration Working Group, one of three Working Groups of the NIS Review Panel. The Terms of Reference for the Collaboration Working Group are given in Appendix 1.

In May 2008 the Minister asked the Review also to evaluate the CRC Program against the principles of appropriateness, effectiveness, efficiency integration, performance assessment and strategic policy alignment. These overlap partially the Terms of Reference.

### 1.1 Approach in this Review

The Review looked at the general issue of collaboration and how it fits within the NIS; and at how the CRC Program fits with other programs in the NIS in contributing to national productivity and social good through collaboration. The Review focused on the major themes coming through the consultations and submissions and sought to understand these in the light of the CRC Program's evolution since its inception in 1990, as reflected in data on the Program and changes to the guidelines. It also considered how changes in funding and incentive systems for CRC participants, especially the public-sector research providers, have affected the way these participants have interacted with the Program. In line with its terms of reference, the Review also drew on the Productivity Commission's Research Report of 9 March 2007, *Public Support for Science and Innovation*, and its comments are referred to throughout this report.

This Report presents the Review's findings and recommendations on the CRC Program.

### 1.2 Process used in this Review

The CWG met 12 times either face-to-face or by teleconference throughout the course of the Review. It provided written papers and regular briefings to the NIS Review Panel. The Panel in turn provided advice on a variety of matters to the CRC Review.

The Review consulted widely. CRCs were a specific topic in all the 'roadshow' workshops conducted for the NIS Review in eight capital cities and participants were encouraged to suggest solutions to problems they raised. These consultations were augmented with more specific consultations with groups involved with the CRC Program and other collaborative programs. This included consultation with individual CRCs, the CRC Committee, the CRC Association, various Commonwealth and State Government departments, the Australian Research Council (ARC), the National Health and Medical Research Council (NHMRC), CSIRO, industry associations, firms involved in CRCs, firms not involved in CRCs, university peak bodies, and universities.

Limited international consultation was also undertaken with the United States, Irish, European Union and United Kingdom systems through visits and through seeking advice from the international advisers to the NIS Review and other visitors. The Review also drew on a visit by the Chair to Ottawa in late 2007 to meet with the Director of the Networks of Centres of Excellence of Canada. Details of consultations through the Review are given in Appendix 3.

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<sup>6</sup> Minister for Innovation, Industry, Science and Research Press Release, 22 January 2008  
<http://minister.innovation.gov.au/SenatortheHonKimCarr>

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A request for comments on the CRC Program was included in the Call for Submissions to the NIS Review released in late February 2008. About 130 of the 630 submissions received made specific reference to the Program, in varying degrees of detail, and these were taken into account.<sup>7</sup>

The CWG examined the role of collaboration in enabling innovation in the NIS. It reviewed the history of collaborative ventures between actors in the NIS and with organisations overseas with a view to understanding some of the strengths and tensions surrounding current funding for collaborative schemes. In this context it looked particularly at how the CRC Program's objectives linked with and complemented other programs in the NIS in contributing to national productivity and social good through collaboration. It also examined how the CRC Program has evolved since its inception in 1990, with a particular focus on the changing guidelines, selection criteria and administrative practice.

The Review also examined the reports and recommendations of previous reviews, and various other studies of the CRC Program. It considered a considerable amount of data and relied on previous work where it still appeared relevant.

The Review sought assistance with the interpretation of economic data from the economists on the NIS Review Panel, Professor Steve Dowrick, Professor John Foster and Dr Nicholas Gruen, and from Professor Alan Hughes, Margaret Thatcher Professor of Enterprise Studies at the Judge Business School, University of Cambridge, who was an international adviser to that Review Panel. Their help is gratefully acknowledged.

Aspects of the Review naturally coincided with the deliberations of the broader NIS Review. In particular, the need for full funding of research became manifestly apparent in both this Review and the 'big' Review and this, along with the funding matters concerning various collaborative research schemes and issues with commercialisation of public-sector research, were referred with comments and suggestions to the NIS Review Panel.

Throughout its deliberations, this Review has been conscious of the Productivity Commission's exhortation that Commonwealth program reviews be conducted with transparency and independence<sup>8</sup>.

The Review has attempted to be thorough and comprehensive in this report, so that the basis on which the recommendations are made is clearly understood. Members of the Review group have varying levels of involvement and engagement with the National Innovation System generally, and CRCs in particular (see Appendix 2), but have independent professional affiliations. The Review chair stood down from all positions connected with CRCs and Commonwealth Government Committees for the duration of the Review. While the Review was supported by staff members of the Department of Innovation, Industry, Science and Research, the Report was produced independently of the Department, and the Review sought information and advice from a wide range of sources.

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<sup>7</sup> Note: footnote references beginning with a number and a name are references to NIS submissions, which can be located on the NIS Review website<sup>7</sup> at <http://innovation.gov.au>.

<sup>8</sup> Productivity Commission Research Report, *Public Support for Science and Innovation*, p. 329.

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## 2 Why the NIS should encourage collaboration

Cooperative Research Centres, as their name suggests, are about cooperation and collaboration in research. Given the nature of this Review and its emphasis on collaboration, the next two chapters are intended to set the scene on collaboration within the NIS as a whole, and give a broader perspective to the CRC Program.

### 2.1 What is collaboration?

Collaboration is an interactive process that involves two or more people or organisations working cooperatively towards a common goal. The process usually involves a joint intellectual endeavour (most likely to be the case for collaboration in the NIS) with the potential to result in net benefit to all parties involved in the collaboration and possibly third parties as well. The joint inputs lead to joint outputs which are greater than either party could achieve on their own. Collaboration is undertaken by organisations of all sizes and from all sectors, public, private and community, as is shown by the extensive literature.

Collaboration is highly valued in innovation systems. A 2005 UK study found that collaboration factors were significantly associated with the innovative efficiency of firms<sup>9</sup>. Collaboration with research providers is the obvious way to bring problem-solving capabilities to end-users.

### 2.2 How does collaboration occur?

The structures for collaboration can vary: there are simple partnerships between suppliers and customers, networks linked to common interests, associations of like industries, industry associations, applied research institutes, formal joint ventures and entities such as CRCs, to the 'mass collaboration' that is being increasingly enabled through advances in internet and broadband technology.

There are many formal structures, underpinned with public funding, that are intended to support and encourage collaboration in research and innovation. These include the CRC Program; the Industry Cooperative Innovation Program (ICIP); rural Research and Development Corporations (RDCs); ARC Programs such as the Centres of Excellence, the Research Networks and the Linkage Grants; the NHMRC Program Grants; and many State Government programs.

### 2.3 Why collaborate?

It pays to collaborate. A study by the (then) Department of Industry, Tourism and Resources in 2006 found that businesses which engage in collaboration are 70% more likely to achieve 'new to the world novelty' or 'creative innovation'<sup>10</sup>.

However, an Australian Bureau of Statistics study found that Australian firms which collaborate typically collaborate with other firms, and not with research organisations or governments:

*In the 2005 Innovation Survey it was found that 26% of innovating businesses were engaged in some form of collaboration. Out of these, only about 3% were engaged in collaboration with government organisations and about 2% were engaged in collaboration with Universities and other higher education institutes. Collaboration with overseas organisation was less than 1%.<sup>11</sup>*

Collaboration in the NIS is important partly to promote activities across those boundaries and partly because:

- a) it enables human and capital resources to be brought together with an ability to create an outcome that cannot effectively be done alone.
- b) it can produce higher quality and more effective, integrated and robust outcomes, as each partner brings a differing perspective and experience to the process.

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<sup>9</sup> Cosh, Fu and Hughes, *Management Characteristics, Collaboration And Innovative Efficiency: Evidence From UK Survey Data*, Centre for Business Research, University of Cambridge, Working Paper No. 311, September 2005, p.23

<sup>10</sup> *Collaboration and Other Factors Influencing Innovation Novelty in Australian Businesses - An Econometric Analysis*, Industry Policy Division, Department of Industry, Tourism and Resources, 2006, p.vi

<sup>11</sup> *Patterns of Innovation in Australian Businesses*, Australia, 2005, Brian Pink, Australian Statistician, ABS, 2007, p.36

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- c) in a small country like Australia, it can be a means of getting scale and overcoming fragmentation caused by distance, diverse jurisdictions and a smaller resource base. For some issues, if we don't collaborate internationally, we may be left out altogether.
  - d) it enables government and government agencies to be partners not just facilitators, which is of particular relevance in promoting public good, not-for-profit research, and in solving social and environmental public good problems.
  - e) it promotes cross-fertilisation of ideas and mutual understandings and can help obtain commitment to decisions and outcomes.
  - f) it can link research providers with research end-users, and encourage the transfer of skills and knowledge and the translation of new ideas into products and services. With so much of Australia's economy relying on SMEs and/or the development of service industries, collaboration is an important means of providing R&D support to these enterprises.
  - g) it can help manage the risk in high-risk areas.

Collaboration is generally thought of as being more natural between parties that are not competing but as Cosh, Fu and Hughes state:

*Collaboration with customers, suppliers, higher education institutions, even competitors, allows firms to expand their range of expertise, develop specialist products, and achieve various other corporate objectives... Collaboration with competitors and customers provides a firm with greater access to domestic or international markets. This may lead to greater commercial success of the new products, and enhances the productivity of innovation through economics of scale. Collaboration with suppliers may lead to lower costs and better quality of the new products. All this may result in higher productivity of the innovation activities. Hence, ... Collaboration will be positively associated with firms' innovative efficiency.<sup>12</sup>*

In short, effective collaboration is an indispensable skill that Australian institutions (private and public) need to acquire. It needs to be part of all business education and education at all levels.

## **2.4 Research collaboration matters – especially for Australia**

Research collaboration is vital in a national innovation system. Peter Ungaro, President & CEO of Cray Inc, manufacturers of supercomputers, told the CRCA08 Conference in May:

*Why collaborate on research?*

- *The new areas of science are at the intersection of the traditional disciplines*
- *Collaboration leads to Gestalt and often unexpected outcomes*
- *Discovery is a global race against time → few prizes for being #2*
- *Every research and development project is a race against time...<sup>13</sup>*

Effective collaboration is important for Australian research. Australia is a small country with only 0.32% of the world's population. It has maintained a good research profile for its size, producing 3% of the world's research papers and having its citizens well represented in major awards such as Nobel Prizes. This performance is critical for our innovation capacity; it earns us a seat at the international scientific table and gives our researchers access to leading knowledge developments and scientific laboratories worldwide. If the links are sufficiently strong, our researchers can be conduits through which Australian companies and government and community agencies can build their knowledge of and absorptive capacity for leading-edge technological developments worldwide. Nurturing and expanding Australia's international research links is vital to our future.

As CSIRO has stated:

*Global linkages need to be supported and funded if we are to access world-class technology, knowledge, people and capital.<sup>14</sup>*

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<sup>12</sup> Cosh, Fu and Hughes, *Management Characteristics, Collaboration And Innovative Efficiency: Evidence From UK Survey Data*, Centre for Business Research, University of Cambridge, Working Paper No. 311, September 2005 (citations removed), p.19

<sup>13</sup> Peter Ungaro, *How does an idea get off the ground?*, Presentation to CRCA08 Conference, <http://www.crca.asn.au>

<sup>14</sup> 217-CSIRO, p.28

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## 2.5 Collaboration risks

Collaboration has traditionally been seen to carry risks in a competitive business environment, though they are risks that can be managed. In the public sector/public good arena, collaboration is less risky and carries more obvious potential for benefits.

The risks of collaboration within an innovation system include:

- the outcomes do not justify the time and resources invested
- the amount of resources required is under-estimated or under-provided, leaving the collaboration consuming more resources than its benefits warrant
- there is a reduction in flexibility instead of an increase, as the vehicle for collaboration takes on its own set of processes and procedures
- the collaboration drifts away from its original mission and purpose
- there is a loss of autonomy and independence of partner organisations
- because the nature of the collaboration is to work on something new, there is no experience in dealing with problems along the way
- the motivations of the partners to be involved change
- all reputations of the partners are at risk should one partner become embroiled in a scandal or controversy.

There is also the risk that the collaboration is seen as an end in itself. This may be associated with 'hollow collaboration' – when groups band together to obtain external funds and then divide up the spoils to obtain an individual benefit – or forced collaboration, which can lead to *significant inefficiencies. Group systems seldom lead to excellence, instead they tend to act as levelling agencies driving everything to mediocrity. The responsibility for achievement and accountability is spread and becomes ineffective. Forced grouping can be anti-collaborative as it becomes difficult for new external parties.*<sup>15</sup>

All these risks are as relevant to joint ventures like CRCs as to any other collaboration. Like any form of collaboration, they need to be addressed and managed using a standard risk management framework in advance of the formal partnering.

### 2.5.1 Important issues in making collaborations work

Some of the matters which collaborators must clarify, and which would be identified through application of a risk management framework include:

- purpose [including fit to strategy, values, timing and expected/hoped for outcomes]
- choosing partners and due diligence on partners
- alignment of interests/understanding the motivations of all parties to the collaboration
- choosing the people who are charged with making the collaboration work – their motivations, rewards and incentives. This applies particularly to the leader/champion
- resourcing the collaboration
- managing the different phases of a collaboration [Start – Middle – End]
- exit points and processes
- governance and audit arrangements
- managing the ownership of the outputs of the collaboration such as intellectual property
- keeping close to and reporting back to owners & sponsors – maintaining their interest and support.

## 2.6 The role of government in encouraging collaboration in the NIS

Despite the obvious advantages of collaboration to solve a range of challenges and problems across all levels of society and in the innovation space, collaboration sometimes needs encouragement. The most obvious way for Governments to be involved is through direct funding programs such as the CRC Program and others listed in Table 1 in the next chapter. If these are well designed, other collaborative strategies can be incorporated too, including:

**Education:** to promote the benefits of collaboration and to teach skills in collaborating effectively and strategically, both through overt programs (in short courses for business or as a subject in a Masters of Business Administration) or deeply embedded (e.g. in school and

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<sup>15</sup> 344-University of Sydney, Deputy Vice-Chancellor (Research), p.2

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undergraduate courses; as part of research training). Researcher education is one of the features of the CRC Program.

As the Department of Education, Employment and Workplace Relations states:

*In setting national innovation priorities, consideration could be given to the skills sets that are necessary for all Australians to effectively and actively engage with new ways of thinking. As a relatively small nation, Australia needs to prepare its citizens to be able to effectively engage with international developments in innovation. A critical mass of skills is essential to achieve this objective. For example, proficiency in new technologies (e.g. digital technologies), multi-lingual skills, enhanced generic capabilities (e.g. problem solving, cooperative behaviours) could be considered essential for participation in innovative processes, understanding of new developments and the ability to embrace innovative products.<sup>16</sup>*

And the Australian Institute for Commercialisation (AIC) notes:

*Our practical experience has shown ... that in order to achieve greater connectivity and collaboration between industry and public research, additional effort must be directed towards a demand-pull approach that addresses the following: ... Cultural change - Increasing the level of awareness, understanding and adoption of open innovation and collaboration practices, particularly within industry.<sup>17</sup>*

**Broker and matchmaker role:** to help small organisations and SMEs to find the right partner for collaboration. There is great potential for more to be done in this area.

**Building on informal collaborations and networks:** especially internationally by encouraging researchers to undertake their PhD studies or postdoctoral research overseas; increasing the outflow of Australian researchers taking study leave in overseas laboratories and the inflow of eminent researchers from overseas to Australian laboratories; holding major research conferences in Australia; and increasing the number of research journals edited by Australians.

There are other things Governments can do too, including:

- promoting realistic IP management by discouraging unrealistic expectations about the potential commercial benefits of IP developed in the public sector, and encouraging research users to be responsible for commercialising and protecting IP
- providing fundamental IT infrastructure such as fast bandwidth, secure, inexpensive and extensive back-up and storage facilities, and improved identity management controls to support the growth of 'mass collaboration' and the increasing trend towards a Creative Commons-style sharing of IP
- providing support for big research infrastructure to ensure Australia can continue being active in research.

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<sup>16</sup> 266-Department of Education, Employment and Workplace Relations, p.7

<sup>17</sup> 113-AIC(2), p.3



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### 3 Collaboration in the NIS in the past – an overview

This section gives a brief overview of the way that research provider/research user collaboration has developed in Australia to provide a historical context for this Review.

Some Australian industries have used collaboration including research collaboration extensively for many years. The models they use offer lessons for other industries.

**Mining and mineral processing:** The Australian mining industry has a long history of collaboration and joint ventures, particularly for exploration, and its research collaborations have built on these. The establishment of an intermediary, the Australian Mineral Industries Research Association (now AMIRA International), to manage research and research interactions with research providers on behalf of several mining companies has been so successful that it has now gone global and is a research intermediary on behalf of the international mining industry. AMIRA has been an important participant in the CRC Program.

**Agriculture:** Australian agriculture also has a long history of collaboration for commissioned research in order to increase productivity and to deal with problems such as pests and diseases. CSIRO, State Departments of Primary Industries, and universities with agricultural and science faculties have all worked closely with agricultural industries for decades. The various rural RDCs and their predecessor bodies have been strategic and successful intermediaries between the industry and the research providers, often seeking to leverage off other Government programs on behalf of the farmers they represent. They too have been active in CRCs.

#### 3.1 Informal links can lead to major collaborations

Some of the best research collaborations are based on informal links that have come about through formal policies of sending Australians overseas for research training and to use major scientific facilities overseas.

For example, many Australians have studied overseas for their PhD degree. Many also have postdoctoral experience in overseas laboratories. The linkages formed then have been the basis of some major scientific collaborations between Australia and other countries. And without such links, Australia's National Innovation system can be at risk. Addressing PMSEC in 1995, Dr Keith Boardman commented on the importance of international networks in research. He said:

*Citations per paper in the international scientific literature are a measure of the visibility of the research and, with reservations, an indication of quality. Australia performs well across most scientific fields ... A disturbing feature ... is the declining share of world citations in a large number of fields of Australian research since the mid-to-late 1980s. ... Some evidence was obtained to support the view that the decline in the visibility of Australian science in the international scene is related to a reduction by Australian scientists in the tapping of international networks. Overseas experience particularly at the post-doctoral level, or for PhD training, is an important way in establishing and maintaining networks. The proportion of academics in Australian universities who obtained their first degree in Australia and their PhD overseas has decreased from 21.5% in 1970 to 11.7% in 1994 (a decrease of 45%). ... The Academy of Science believes that the lack of post-doctoral fellowships for study overseas is an important policy issue which has a bearing on future successful international collaborations.<sup>18</sup>*

Even the links formed through the necessity of accessing international facilities that Australia can't afford alone can be valuable as Professor John White argued in 2005:

*One matter that we believe to be quite important is that retention of access by Australians to overseas facilities as well as the attraction of overseas users to Australia. It is essential that, by the construction of home based facilities, Australia does not lose the extensive collaboration that has developed through our scientists and academics and industrial colleagues having been forced to do "suitcase science" over the past twenty*

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<sup>18</sup> *Australian Science and Technology - The Science Base*, A comment prepared by Dr N K Boardman, AO, FAA, FTSE, FRS for the meeting of the Prime Minister's Science and Engineering Council, 13 September 1996. See <http://www.science.org.au/reports/pmsec.htm>



years. These collaborations and the interchange of ideas prevent “inward looking” isolation of Australia.<sup>19</sup>

Other valuable informal networks can flow from research co-location. For example CSIRO has often made arrangements to locate Divisions on university campuses to considerable mutual benefit and benefit to others.

Yet other valuable research collaborations come from academic consulting to industry, generally permitted for up to day a week in most academic employment arrangements, and through international research conferences held in Australia.

### 3.2 Formal development of major research collaborations

The 1980s saw the emergence of greater emphasis on research collaboration in several countries and regions, often research collaborations in fast-moving technical fields with strong economic imperatives. Some examples from that time include:

- the EU’s information technology Esprit and then Framework Programs
- the advanced information technology Alvey Program in the UK
- the development of Kansai Science City in Japan.

Australia also introduced an increasing number of collaborative research programs. Some (but by no means all) are described briefly in Table 1.

**Table 1: Some major collaborative research schemes introduced in Australia 1980-2008**

Year	Activity
1982	Centres of Excellence established, later called ARC Special Research Centres (SRCs). They were funded on the basis of research excellence and their potential to contribute to the economic, social and cultural development of Australia. SRCs were generally funded for nine years, with performance reviews being conducted in the third and sixth years. SRCs were established in 1982, 1988, 1997 and 2000.
1985	The first Key Centres of Teaching and Research (Key Centres) were established to enable education to respond to emerging needs for the development of expertise in fields important to national development. Key Centres linked teaching with basic and applied research. Key Centres were generally funded for six years, with performance reviews conducted in the third year. Key Centres were established in 1985, 1988, 1989, 1990, 1991, 1995 and 1999.
1989	The Australian universities and the CSIRO, under the umbrella of the Australian Vice-Chancellors' Committee (AVCC), initiated a project called the Australian Academic and Research Network (AARNet) - this was the genesis of the Internet in Australia. Initial funding came from the AVCC, CSIRO and the ARC.
1990	The Cooperative Research Centres Program was introduced. Rounds were held in 1990, 1991 and 1992 then annually, with the most recent round in 2006.
1991	Collaborative Research Grants Program (later Strategic Partnerships with Industry–Research and Training (SPIRT) Scheme; still later Linkage Grants Scheme) introduced. Linkage Grants still running with rounds twice a year.
2001	Major National Research Facilities (MNRF) Programme provided funding of more than \$150 million over five years from 2001-02 to 2005-06 for the establishment of 15 facilities (selected through a competitive process).
2002	Australian Centre for Plant Functional Genomics (selected through a competitive process) was announced in May 2002. The ARC and the GRDC together provided \$20 million over five years to establish the ACPFG at the University of Adelaide. The South Australian Government also committed \$12 million.
2002	National ICT Australia (NICTA) was established in October 2002 with the signing of a five-year \$124.8 million Funding Deed by NICTA with the Australian Government following a competitive selection process. Funding was subsequently extended to 2010-11. The Centre is co-funded by the ARC and the Department of Broadband, Communications and the Digital Economy and its partners.

<sup>19</sup> Professor John W. White (President), Australian Institute of Nuclear Science and Engineering (AINSE) response to the National Collaborative Research Infrastructure Strategy (NCRIS) “Exposure Draft” (Strategic Roadmap) , December 2005, p.9. Available at <http://www.ncris.dest.gov.au>

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2002	New ARC Centres of Excellence first round results were announced in December 2002 - eight Centres funded. Funding for an additional nine Centres (called ARC Centres) was announced in August 2003. 11 new Centres (of \$1-3 million per year over five years) were announced in June 2005. ARC Centre of Excellence in Policing and Security was announced in 2006. Centre for Groundwater Research and Training (co-funded by ARC and the National Water Commission) to be announced in 2009.
2003	CSIRO National Research Flagships - large-scale multidisciplinary research partnerships that harness world-class expertise to tackle national priorities commenced. The total investment from 2003 to 2011 is expected to be close to A\$1.5 billion.
2003	The National Stem Cell Centre (now known as the Australian Stem Cell Centre, ASCC) was established as Australia's Biotechnology Centre of Excellence in May 2003. The Centre is co-funded by the ARC and the Department of Innovation.
2005	National Collaborative Research Infrastructure Strategy (NCRIS) is providing \$542 million over 2005-2011 for major research facilities, supporting infrastructure and networks necessary for world-class research.
2005	The Commonwealth Environment Research Facilities (CERF) initiative was funded from 2005-06.
2008	The Defence Future Capability Technology Centre (DFCTC) Program, modelled on the CRC Program, announced its first Centre .

The schemes mentioned in Table 1 are Commonwealth Government schemes. The States have also been active in encouraging collaborative research ventures both through the introduction of formal schemes such as Queensland's Smart State Programs and Victoria's Science, Technology and Innovation Initiatives, and through mechanisms to leverage funding through Commonwealth collaborative schemes into their States.

Many Commonwealth schemes that are explicitly not about collaboration have been good for fostering it however. For example, there has been a growth in recent years of micro-enterprises claiming the R&D Tax Concession for work commissioned from Registered Research Agencies.

Philanthropy is increasingly a collaboration catalyst in Australia. For example, Atlantic Philanthropies in Queensland has been a catalyst in major collaborations between the State government and various universities and hospitals. The Potter and Myer foundations have also acted in this way. The Potter Foundation supported the Bookmark Biosphere Reserve on the Victorian/South Australian border; and funded the renewal of Lizard Island Research station on a leveraged basis with the Australian Museum and the Queensland Government.

### 3.2.1 Continuing the collaborative momentum

Australia has become increasingly sophisticated in supporting collaboration among and between different groups: researchers, industry, public-sector and community end-users. The various schemes have been successful to differing degrees and have influenced each other in their evolution, but the system has, inevitably, become complex and the results are hard to track (no easily comparable data) and evaluate as a whole. Essentially we have been running a big but somewhat under-designed experiment in what constitutes research collaboration. We can – and must - learn from our successes and failures in order to move to a new stage of more effective collaboration.

*A complex NIS has arisen from the tendency to add new initiatives, entities and governance arrangements in response to new challenges and opportunities, without necessarily removing those which have become less effective, moribund, or simply redundant. This has been especially so in programs introduced to enhance collaborations; over the past two decades we have seen the development of the Cooperative Research Centres (CRC) Program, the Australian Research Council's (ARC) Centres of Excellence, the ARC Linkage Grants, the Commonwealth Environment Research Fund (CERF), the CSIRO Flagship Collaboration Fund, National Collaborative Research Infrastructure Scheme (NCRIS) and more, all with different, often incompatible governance arrangements. While each of these programs has individual*

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*merit, when taken as a whole they tend to add complexity and cost without any obvious benefit to the system overall or the outcomes expected from it.<sup>20</sup>*

In line with its terms of reference the Review has been conscious that the CRC Program does not stand alone in the minds of participants and potential participants, and that its role and usefulness must be assessed in light of other NIS programs.

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<sup>20</sup> 217-CSIRO, p.15

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## 4 The CRC Program

### 4.1 Introduction

The CRC Program was established by the fourth Hawke Government in 1990, having been designed by Professor Ralph Slatyer, the then Chief Scientist, primarily to encourage collaboration in research between the private sector and the public sector research bodies but also to address research concentration for world-class teams and preparing PhD graduates for non-academic careers.

Professor Slatyer said that:

*What I envisaged ... was ... a Centre which would be something of a 'One Stop Shop' for innovation, consisting of a cooperative team of researchers and research users, drawn from various organisations, and of adequate size and composition to have a real and continuing impact in the sector where it was located. I envisaged that the research organisation participants would undertake mainly long term strategic research- in other words work at the R end of the R&D spectrum- and the research users would work mainly at the D end.*<sup>21</sup>

### 4.2 Basic facts and figures

The CRC Program was initially administered through the Department of the Prime Minister and Cabinet, and moved with the Science portfolio in its various guises. To date there have been 10 selection rounds under eight Ministers. Rounds were annual in the first three years, and then biennial. There have been 168 CRCs over the life of the Program; 102 if renewals or new-from-existing are not counted separately. During 2007-08, 58 CRCs were funded. Of these, 25 are in their 1<sup>st</sup> funding term, 16 in their 2<sup>nd</sup> term and 17 in their 3<sup>rd</sup> term. Nine CRCs reached the end of their funding term in Jun 2008, hence there are 49 CRCs receiving funding in 2008-09. The first round resulted in 20 CRCs; the last round in 2006 resulted in three new CRCs, seven new-from-old CRCs, and four extensions of funding for existing CRCs for supplementary projects.

The total investment by the Commonwealth is of the order of \$3 billion, with a further \$9 billion leveraged from participants. The leveraged funds include \$2.9 billion from universities; \$1.1 billion from CSIRO; and \$2.3 billion from industry.

### 4.3 How the Program is run

#### 4.3.1 Program Design

This section is based on the 2006 guidelines:

##### 4.3.1.1 Objective

The objective of the CRC Program is:

*to enhance Australia's industrial, commercial and economic growth through the development of sustained, user-driven, cooperative public-private research centres that achieve high level of outcomes in adoption and commercialisation.*

##### 4.3.1.2 Eligibility

The guidelines state:

*Applications need to be from collaborations with:*

- *at least one Australian higher education institution (or research institute affiliated with a university) among its core participants; and*
- *at least one private sector participant among its core participants ...*

*There is no restriction on the fields of research that may be included in a CRC, but every CRC must include some research in the natural sciences or engineering.*

*Applications must involve all of the following: undertaking research, commercialisation/ utilisation activities and education and training activities (including a PhD program).*

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<sup>21</sup> Ralph Slatyer, *Cooperative Research Centres: A retrospective view*, Annual Meeting of the CRC Association, May 2000: <http://www.crca.asn.au/activities/2000/Slatyer>

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#### **4.3.1.3 Application process**

Applications have been called every two years since 1992 (the first 3 rounds were annual). Applicants are required to complete a Stage 1 Business Concept Case to indicate the level of resources required, and to demonstrate that they have a 'strong science/research proposal, industry support, a route to market', and competitiveness at Stage 2 level. The business case has to include a description of

- the expected key outcomes and the economic benefit arising from the education and training program (including specific information on how the benefit will be achieved)
- how the outcomes will make a substantial contribution to Australia's industrial, commercial and economic growth (including the main assumptions that underlie the estimation of the potential)
- the major industrial, commercial or economic needs or opportunities the outcomes will address
- the expected impact of the outcomes for end-users
- the key markets and potential end-users
- strategies for the commercialisation or utilisation of the research outputs and why these are appropriate to achieve the CRC outcomes for end-users
- the core participants and their roles in research, commercialisation/utilisation, and education and training
- an overview of the research program and key research questions
- the innovative features of the research
- the education and training program
- the amount of Commonwealth funding sought
- total staff and financial resources required
- strategies to obtain staff and financial resources.

At Stage 2, applicants are required to submit a Full Business Case. Additional requirements include:

- details of the 'scale (quantity and value)' of each outcome's contribution to growth and the basis for estimation. Principles for developing estimates of future net economic benefits are provided in an Appendix, and cover opportunity cost, attribution to the CRC, adoption costs, time lags, quantification of benefits, accounting for risk and discounting of future benefits.
- details of the assumptions underlying the estimation of the value of growth, including an indication of the baseline positions of the industry sectors and how the CRC will make a difference to the baseline positions
- the estimated economic returns from any new or emerging industry
- strategies for IP management
- research program milestones
- a high level organisational chart
- details of postgraduate enrolments, outcomes and outputs
- strategies for maintaining the benefits of collaboration and for closing/continuing the CRC after Commonwealth funding ends.

#### **4.3.1.4 Funding terms**

CRCs are funded for up to seven years (in practice, all or nearly all have been for the full 7 years). There is no restriction on the number of funding terms an existing collaboration may seek. However, existing CRCs apply under slightly different guidelines. If approved they are treated as new-from-existing CRCs and funding for the last year of the old collaboration is transferred to the first year of funding for the new collaboration.

#### **4.3.1.5 Funding**

Participants in the CRC must provide cash and in-kind contributions that together will at least match the amount of funding sought from the CRC Program over the funding period. Firm commitments by individual participants may be for some or all of the years of the funding period.

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#### **4.3.1.6 Decision-making**

The Minister decides which CRCs will be funded and the conditions of any funding offer. In making decisions, the Minister may take into consideration the advice of the CRC Committee, as well as other matters including the application itself and any other related documentation.

#### **4.3.1.7 CRC Committee**

The CRC Committee role is to assess funding applications, oversee the monitoring and reviews of CRC activities and the CRC Program, and make recommendations on these to the Minister. It consists of up to 13 members, drawn from industry, research providers and Australian Government agencies involved in research or research funding, appointed by the Minister for up to 5 years.

The Committee meets at least twice during the process of assessing applications, and at least twice annually to review CRCs' activities. It operates in accordance with a code of conduct, conflict of interest and confidentiality guidelines<sup>22</sup> and a Probity Adviser provides advice and assistance throughout the application and selection process.

#### **4.3.1.8 CRC Lifecycle**

Once approved and established, the CRC is subject to a 1<sup>st</sup> year visit and a 3<sup>rd</sup> year review; and has to meet the routine requirements of the contract with the Commonwealth.

As a CRC approaches the end of its funding term, it can plan to:

- continue as a non-CRC-Program-funded entity
- wind up its activities, or
- re-bid for another term of funding, in which case it returns to the beginning of the CRC lifecycle.

### **4.4 Data on participants<sup>23</sup>**

The biggest single contributor throughout the life of the Program has been CSIRO, which has contributed \$1,097 million. The bulk of its contribution has been in kind (\$1,080 million) but it contributed \$17 million in cash as well. It has been in 122 CRCs in total.

The next three biggest contributors were the University of Queensland (\$288 million over 59 CRCs), the University of Melbourne (\$275 million over 39 CRCs), and Monash University (\$220 million over 42 CRCs). Indeed, eight universities were in the top 10 contributors to the Program and 15 were in the top 20 contributors to the Program. Universities typically contributed a higher cash percentage than CSIRO. The University of New South Wales contributed \$28 million in cash; Monash University \$25 million; the University of Melbourne \$21 million; and the University of Queensland \$19 million.

Industry bodies have been very big contributors to the Program especially in the agriculture and mining sectors. The biggest single cash contribution to the Program comes from the GRDC (\$52 million cash and \$27 million in-kind over 13 CRCs) and AMIRA International (\$43 million cash over seven CRCs and a further \$2 million in-kind). In particular, the rural RDCs have used the CRC Program to advantage, leveraging significant CRC funds to assist with the programs they carry out for farmers with the levy contributions and the government matching contributions to the levies. As well as the GRDC, other notable examples include the Cotton RDC (\$31 million cash and \$4 million in-kind over three CRCs); Meat and Livestock Australia Ltd (\$29 million cash and \$6 million in-kind over nine CRCs); the Grape and Wine RDC (\$20 million cash in one CRC); Australian Wool Innovations Ltd (\$18 million cash and \$7 million in-kind over four

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<sup>22</sup> See <https://www.crc.gov.au>

<sup>23</sup> The data provided here has been taken by the Department of Innovation, Industry, Science and Research from a database developed to consolidate data from a number of Government Programs managed by various agencies, including the CRC Program. As each agency collects various information in different ways, such as how organisation types are classified, some of the data has been adjusted to fit a single classification. As a result the data extracted from this database may not exactly reflect data provided by the relevant agency, and there is a potential for errors to have occurred during the amendment/standardisation of data. The contributions shown for Participants are the Contracted amounts. Generally, it is expected that the Actual contributions made will exceed the Contracted contributions. Data regarding Supplementary funding to CRCs is recorded against the year in which the CRC commenced, not the year the Supplementary funding was awarded. For data consistency across the various programs for which data has been collected, financial years have been converted to calendar years. In the case of CRCs, the calendar year represents the year in which the financial year commences (ie, 1991 calendar year relates to the 1991-92 financial year).



CRCs); Fisheries RDC (\$18 million cash and \$2 million in-kind over two CRCs); and Dairy Australia Ltd (\$16 million cash and \$5 million in-kind over five CRCs).

About 270 Large Enterprises (LEs) were involved in CRCs, about 5% of the 5900 LEs (businesses with 200 or more employees) in existence as at June 2007.<sup>24</sup> About one-third of these contributed \$1 million or more in cash.

About 300 SMEs have been involved as individual participants in CRCs, with about 40 putting in \$1 million or more in cash. Given that there are 834,000<sup>25</sup> employing SMEs in the country (of which 78,300 have between 20 and 200 employees) this proportion is very small. Some innovative programs have been established to engage SMEs, notably 43 Pty Ltd, a company established under the CRC for Spatial Information's umbrella to represent its 43 SME participants, and the SME Clubs started by some CRCs to keep SMEs in the sector informed of CRC activities. While exact numbers are difficult to obtain, even if a further 300 SMEs are involved in CRCs through these kind of intermediaries, the proportion of SMEs involved in CRCs is well under 1%.

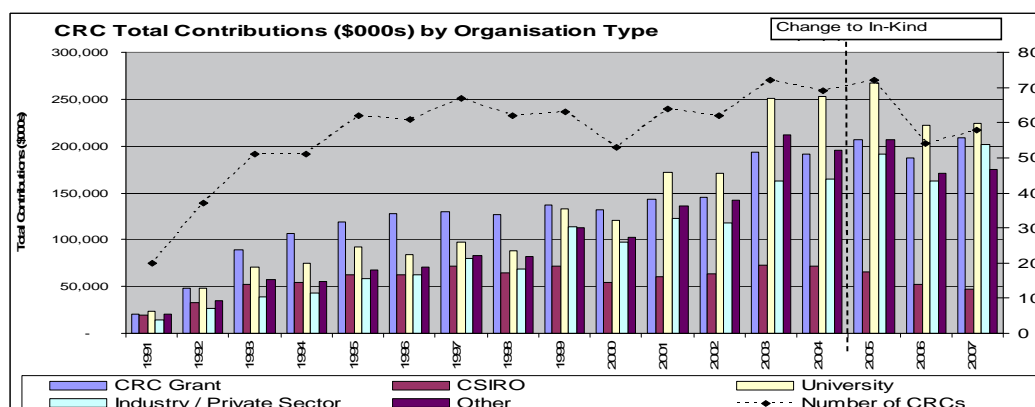
Government departments have also been significant contributors to the Program. For example, the NSW, Western Australian and Queensland primary industries departments have each contributed over \$100 million. Significant Commonwealth CRC partners have been Geoscience Australia and the Australian Antarctic Division of DEWHA, each contributing over \$70 million over the life of the Program.

## 4.5 Analysis of Participant Contributions

### 4.5.1 Trends of participant contributions by year

Figure 1 shows the contributions made to CRCs by organisation type in each year, displayed in dollars of the day. Contributions shown are total contributions, i.e. the sum of the three types which can be broadly categorised as cash, staff in kind and non-staff in kind. Contributions shown are cumulative and come from the sum of contributions to various CRCs from different rounds but provided over the life of a CRC in different years. In interpreting the data in the graphs, it is important to note the change to the way staff in-kind contributions were estimated in the 2004 and 2006 rounds. This change is discussed further in 4.5.2 below.

Figure 1: Contributions to CRC Program by Organisation Type



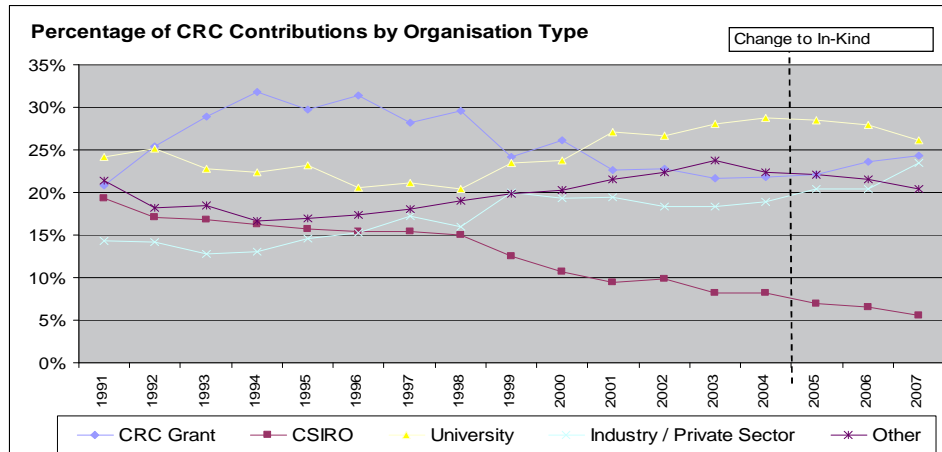
Contributions from the various participant groups have been rising with a significant jump in 2003, but then a decline in 2006. This is consistent with the rise and fall in the number of CRCs operating in each year and the level of Program funding, and with the time-lag impact of commitments made at the time of a bid but contributed throughout the life of a CRC. Care needs to be taken in interpreting this graph as Program objectives and Program rules have changed with different rounds and these changes have probably affected the levels of contribution at different rounds differentially.

<sup>24</sup> ABS, 8165.0 - Counts of Australian Businesses, including Entries and Exits, Jun 2003 to Jun 2007

<sup>25</sup> *ibid.*

Figure 2 displays the same data as Figure 1 but this time on a percentage basis by classes of various participant types. This figure shows that, proportionally, CSIRO's investment has been declining since the commencement of the Program and that, in general terms, through most of the life of the program, proportional contributions from universities, industry, industry associations and State governments have been rising.

**Figure 2: Percentage of Contributions to CRC Program by organisation type**



#### 4.5.2 Contributions in 2004 and 2006

In order to attempt to disentangle the effect on participant data trends of changes in the Program at different rounds, the Review also considered participant commitments made in each selection round.

For the 2004 selection round, the Commonwealth introduced rules for assigning values to staff in-kind contributions to replace the practice where the value of contributions was determined by the participant. The different multipliers used by various participants to account for on-costs and overheads made it difficult to determine comparatively the actual resources being made available to the CRC. The standardised approach enabled the CRC Committee to evaluate the commitment of staff and their time, not the cost of employing them. However, this makes comparisons of the 2002 round to the 2004 and 2006 rounds difficult. The effect is strongly pronounced for the research providers who provide a greater proportion of staff in-kind contributions.

#### 4.5.3 Trends of participant contributions by selection round

**Figure 3: Contributions to CRC Program by Organisation Type by selection round**

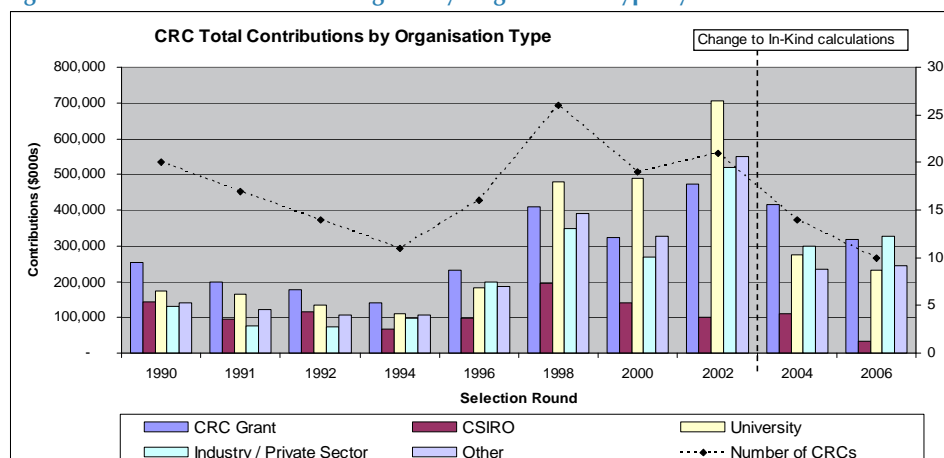


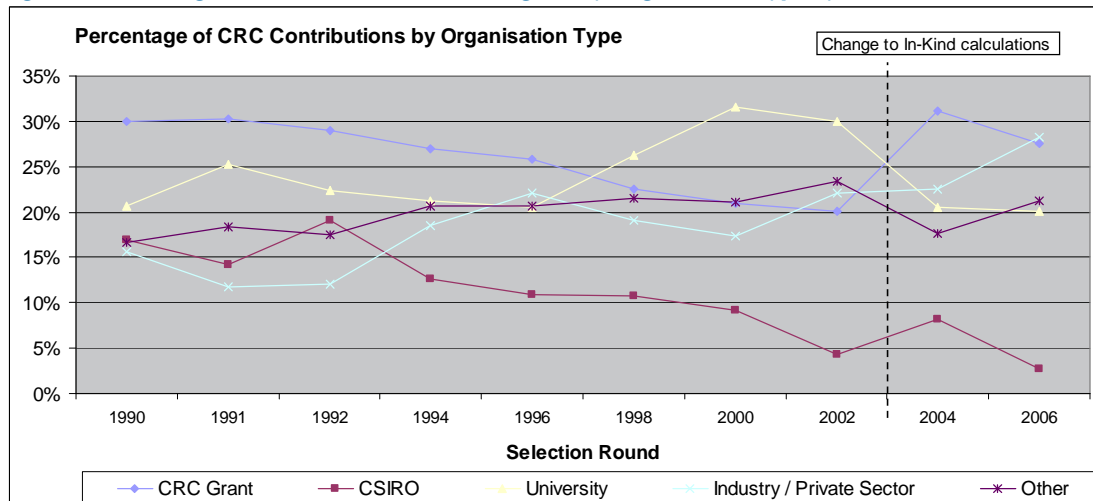
Figure 3 displays participant contribution data by selection round; a display which makes it easier to see what is happening with contributions as the Program objectives and guidelines have changed over time especially if the number of CRCs funded in each round is factored in.



Contributions peaked in the 2002 selection round (when 21 new or new-from-existing CRCs were funded), before declining sharply in 2004 and 2006. This decline is in part a result of the decline in the number of CRCs funded and the level of Program funding; and the introduction of standardised valuation for in-kind staff.

The same data are displayed on a proportional basis in Figure 4. Proportionally CSIRO contributions have been declining since the 1992 round, and in general terms, industry contributions have been rising.

**Figure 4: Percentage of Contributions to CRC Program by Organisation Type by selection round**



More detailed data on participant group contributions can be found in Appendix 4.

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## 5 Earlier Reviews of CRC Program

To date there have been three specific reviews of the CRC Program (the Myers Report; Mercer & Stocker; and the Howard Partners Report). The Program was also reviewed as part of a wider review of business programs by David Mortimer in 1997; and examined in some detail by the Productivity Commission in its 2007 science and innovation study.

### 5.1 Myers Report

The first external review of the Program occurred in 1995, when 61 CRCs had been established: *Changing Research Culture Australia – 1995, Report of the CRC Program Evaluation Steering Committee*, July 1995 (Myers Report).

The report found that the CRC Program was ‘very well conceived’ and that the prospects of the Government’s broad objectives for the scheme being achieved were ‘excellent’. It concluded that CRCs were supporting high quality research activities and strong collaborative networks, that CRCs had made a ‘substantial contribution to increasing the linkages between researchers, industry and other research users’, that the CRC Program had been ‘outstandingly successful in expanding cooperation among researchers’, and that CRCs had been ‘highly effective in establishing strong and qualitatively different education programs that are producing graduates highly valued by industry and other research users’.

Its recommendations centred on maintaining the scheme, encouraging CRCs to be self-funding, acknowledging the need to terminate funding of poorly performing centres, improving administration, management and governance structures (including encouraging but not imposing incorporation and independent Board chairs), improving performance monitoring, maximising the breadth of industry involvement, improving publicity about the Program, encouraging greater SME involvement, emphasising the importance of education and training as part of CRC activity and improving research training processes.

### 5.2 Mortimer

In 1997 David Mortimer reported on the efficiency and effectiveness of *all* Commonwealth business programs in *Going for Growth: Business Programs for Investment, Innovation and Export*, June 1997.

It briefly commented on the CRC Program, finding that the Program was flawed, in that it funded institutions (the providers of research) rather than research activities, and that it conferred a private benefit to participants in the majority of cases. Consequently it recommended that funding for CRCs with a predominately private benefit be terminated at the scheduled date, and that the CRC Program budget be reduced to \$20m per year (cf to \$133m in 1995-96<sup>26</sup>), to focus on predominantly ‘public good’ collaborative scientific programs.

It stated that CRC activity fell into two categories:

- ‘public good activities’ for which there is little private benefit to be derived by any one industry or business; and
- ‘private good activity’ where collaboration is a necessary pre-competitive activity and leads to a private benefit for particular industries or businesses.

### 5.3 Mercer & Stocker

Shortly after the Mortimer report was the *Review of Greater Commercialisation and Self Funding in the CRC Programme* by Don Mercer and John Stocker in May 1998. It specifically concluded that the Mortimer criticisms were ‘unfounded’ and that concerns about excessive levels of private benefit were overstated.

Like the Myers Report, it was very positive about the CRC Program’s ‘important role in the Australian innovation system’ and said it represented an ‘effective investment of public money in R&D’. It noted that the CRC Program had attracted international attention as a ‘successful mechanism for linking users with research organisations’. It also found that the CRC Program *addresses important weaknesses in the national innovation system, in particular the disincentives to collaboration among research providers, the weak links between*

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<sup>26</sup> From p.13 of Mercer Stocker Report

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*research organisations and users, the lack of critical mass due to the institutional and geographical dispersion of Australian research and research application, the lack of mobility of personnel between government research, academia and industry, and the challenges of effective international links for a country isolated from the international centres of research and innovation. The Program complements the work of the universities, CSIRO and other research organisations. It stimulates greater industry spending on R&D and greater industry involvement in guiding R&D in the public sector.<sup>27</sup>*

The review's recommendations focused particularly on strengthening CRC governance; but also recommended that the provision and withdrawal of core funding be staged and linked to performance reviews, an issue also addressed in this review.

It identified four categories of knowledge generated and disseminated by CRCs:

- scientific knowledge of wide potential application
- knowledge relevant to environmental, health or other non-commercial community objectives
- knowledge that contributed to commercial benefits in business enterprises but cannot be appropriated as IP
- commercial IP.

#### **5.4 Howard Partners**

In 2003 Howard Partners delivered a report: *Evaluation of the Cooperative Research Centres Programme*, July 2003.

They noted that the objectives for the Program established in 1991 had, by 2003, 'drifted significantly'<sup>28</sup> and become 'more generic'. Howard Partners recommended that there be an overarching purpose 'to achieve closer linkages between science and the market by matching the technological capability provided by Australia's strong public research base with the requirements of industry and other research users', with seven objectives:

- contributing to Australia's economic growth, social well being and environmental outcomes
- developing Australia's public and private industrial research capacity in areas of national need or global opportunity
- producing applicable research that is of an excellent standard
- adding to the nation's intellectual property and promoting its adoption, application and use in businesses and public programs
- producing graduates with skills, knowledge and experience in the application of research in a national, industry and/or business context
- enhancing collaboration among public and private researchers
- upgrading the innovative capacities of Australian business enterprises.

Howard Partners reported that, since the Program had been introduced, there had been a 'profound change' in Australia's research and innovation culture.

It was of the view that there were 3 categories of CRC:

- those operating as national benefit centres, with a focus on resource sustainability
- those operating on industrial research collaborations leading to industry performance improvement
- those operating as business development centres, with a focus on research commercialisation.

It reported that 'the data suggest that there has been a discernible trend towards a greater emphasis on national benefit CRCs over the life of the program'.

It also reported that, in the area of collective industry benefit, the Program had had a 'major impact in mature industries that have strong leadership, a production orientation, and a focus on

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<sup>27</sup> p.iii  
<sup>28</sup> p.xiv

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global markets and international competitiveness. Collaboration tends to be 'pre-competitive' and strongly directed towards innovation in industrial processes and business practices.'

It reported that the Program had been strongly influenced by the extent of the existing match between the technology-push from the research base and the demand-pull from potential research users. When the match was strong (e.g. environment and minerals industry) then CRCs performed well on research, education and collaboration outcomes. When there was little or no pre-existing capacity to match technology-push and demand-pull then the performance of CRCs was more mixed. This Review agrees.

The recommendations of Howard Partners focused on positioning the CRC Program as an 'investment' program, with preferential treatment to robust 'investment propositions' based on industrial research as a means to an end, not an end in itself. While proposing that there be a renewed focus on the Program's objectives, it also called for strengthened management, accountability, reporting, governance and evaluation mechanisms. On the governance side, it stopped short of recommending incorporation for all CRCs recognising that there were advantages and disadvantages to both incorporated and unincorporated joint venture models.

## 5.5 Productivity Commission

In early 2007, the Productivity Commission produced an extensive report on *Public Support for Science and Innovation: 9 March 2007*. Its chapter on CRCs reported on widespread criticism about the 'excessive and burdensome' costs of compliance and administration. It also found concerns about the substantial financial and in-kind commitments required of CRC participants; and about the inflexibility of the seven-year Program structure.

Also by the time of the 2004 and 2006 rounds, the main objective of the Program had been changed:

*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.*

The Productivity Commission noted that this was a significant departure from the previous objectives, which had been evenly balanced across research excellence, effective collaboration, education and economic, social and environmental benefit. It argued that the emphasis on commercialisation was less defensible from an economic efficiency perspective and more likely to result in research collaborations of a type that a firm or industry collective would undertake anyway. It also expressed concern that public support for social and environmental research activity had been reduced, given their potential impacts, their fundamental role as an input to public policy, and increasing Australia's preparedness to deal with social and environmental issues.

It also found that very few CRCs generated sufficient commercial returns, despite the emphasis on commercialisation, to operate successfully beyond the funding period. It recommended that a greater emphasis be placed on translating research outputs into economic, social and environmental benefits.

The Productivity Commission stated that one other downside of the complex structures required for CRC Programs was its deterrent effect on the involvement of SMEs in CRC activities. The Productivity Commission strongly encouraged the development of 'smaller, shorter and more flexible arrangements between groups of firms', particularly ones that would encourage SMEs to participate. It proposed some potential mechanisms, including:

- *an entitlement-based program such as a tax concession (or credit) where all proposals that meet the eligibility criteria receive support but with ex post safeguards in place to guard against abuse (in the same way that the ATO polices the present tax concession scheme). This approach has the advantages of funding continuity and allowing decentralised decision-making on the type of research to be undertaken but its open-ended nature will increase the potential revenue cost of the program.*
- *a grant program for collaborative research proposals where support is made available at regular intervals throughout the year and allocated on a 'first-come-first-served' basis (subject to eligibility). This would also allow for decentralised decision-making, places a*

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*cap on the cost to revenue and allows for considerable flexibility in the timing of research.*

- *applications are invited and assessed on an individual basis to determine whether they have sufficient merit to receive a grant. Proposals could either be disallowed at this initial stage if they did not meet the merit or other eligibility criteria or at a later date (with a requirement to repay the grant) if applicants failed to meet their obligations. This would involve lower administrative costs than the current CRC process but also increase the potential revenue cost.*
- *a competitive program is introduced with proposals ranked against each other and grants awarded to the best proposals. This is similar to the current CRC assessment process and, accordingly, would raise similar concerns in relation to administrative and compliance costs.<sup>29</sup>*

but it favoured an enhancement of the ARC Linkage Program.

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<sup>29</sup> Productivity Commission Research Report, *Public Support for Science and Innovation*, p.458

## 6 CRC changes as reflected in the Objectives and Selection Criteria

Some aspects of the Program have remained unchanged, in particular the requirement that at least one higher education institution be a participant in every CRC. However, the Review was struck by the significant changes in the Program's objectives and selection criteria over the life of the Program. Some key changes are summarised below (see Table 2 and Table 3), to paint a picture of the development and evolution of the Program. With the various changes to the portfolio administering the Program, the reasons why the changes were implemented has not been readily accessible, but in the main they arose out of the Reviews described above, specific Government policy initiatives, and the CRC Committee's own review and analysis processes.

### 6.1 Program Objectives

**Table 2: Comparison of CRC Program Objectives**

1990-1992 (similar for 1994-1998)	2000-2002	2004-2006
<p>TO support long-term high-quality scientific and technological research which contributes to national objectives, including economic and social development, the maintenance of a strong capability in basic research and the development of internationally competitive industry sectors;</p> <p>TO capture the benefits of research, and to strengthen the links between research and its commercial and other applications, by the active involvement of the users of research in the work of the Centres;</p> <p>TO build centres of research concentration by promoting cooperative research, and through it a more efficient use of resources in the national research effort;</p> <p>TO stimulate education and training, particularly in graduate programs, through the active involvement of researchers from outside the higher education system in educational activities, and graduate students in major research programs.</p>	<p>TO enhance the contribution of long-term scientific and technological research and innovation to Australia's sustainable economic and social development;</p> <p>TO enhance the transfer of research outputs into commercial or other outcomes of economic, environmental or social benefit to Australia;</p> <p>TO enhance the value to Australia of graduate researchers; and</p> <p>TO enhance collaboration among researchers, between researchers and industry or other users, and to improve efficiency in the use of intellectual and other research resources.</p>	<p>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.</p>

In the first three rounds the emphasis was on supporting research for general national objectives, research user involvement, cooperative research, and researcher education. 'National objectives' were spelled out in the guidelines as being 'the development of internationally competitive (primary, secondary and other) industry sectors, the health and well-being of Australian society, and the understanding and management of the environment'.

These CRC objectives substantially continued during the 1994, 1996 and 1998 rounds, though there was some re-arrangement of wording and order in each round. However, there were three significant changes: 'basic research' was dropped, and 'strengthening of research networks' and 'active involvement of users in the management of Centres' was added. The key emphases were again on general national objectives (excluding basic research capability), research user involvement and control, researcher education and research cooperation. The definition of 'national objectives' provided in the earlier rounds was given an additional strand – 'and the interaction of these to achieve ecologically sustainable development'. The selection criteria up

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to 1996 all referred to the realistic potential of the research to lead to significant social as well as economic benefits. In 1998, while the overall Program objectives had not changed, there was little reference to 'social' benefits in the guidelines. The selection criteria spoke broadly about the contribution to 'national objectives', but there was greater emphasis than in previous years on the potential commercial value, on technologies that could assist Australian industry, and on strategies for utilisation and commercialisation.

The CRC objectives for the 2000 and 2002 selection rounds were shortened, 'cooperation' was changed to 'collaboration', and for the first time 'sustainable', 'innovation' and 'environmental benefit' were specifically included. There was a noticeable shift of emphasis to: sustainable economic and social development, transfer of research outputs, graduate researcher value and collaboration and efficiency. However, the possibility of research benefiting public sector end-users, through improvements in environmental management or health services, was still envisaged.

For 2004 and 2006 there was a single objective. The change in emphasis here was quite marked: on growth, research users, and research adoption/commercialisation. The early commitments to pure research and the objective of social development were dropped, and the focus was on harder-edged outcomes for end-users. There was no reference either to the long-standing commitment to researcher education, though the guidelines' eligibility requirements specified that applications had to involve 'education and training activities (including a PhD programme)'.

The way that CRC bids are assessed for their potential to meet the objectives is through the selection criteria. These too tell a story.

## **6.2 Selection Criteria**

The CRC rounds from 1991 to 1996 used similar selection criteria. In 1996 there were 12 criteria applied to the assessment of applications, grouped into five categories. For the 1998 round, there were 19 criteria, grouped into seven categories. For 2000 and 2002 there were nine criteria in eight categories. By 2004 and 2006 there were just four criteria, directly linked to the one-sentence objective of the CRC Program. In 2008 these were reduced to just three when applications for the Defence Future Capability Technology Centre, modelled on the CRC Program, were called and decided.

The guidelines for the 1<sup>st</sup> CRC selection round were 15 pages long. The guidelines for the 2006 CRC round were 35 pages long, with a further 55 pages of appendices, mostly forms.

## **6.3 International Participants**

The original guidelines also acknowledged the importance of international collaboration and permitted overseas-based companies to participate as full partners in Centres 'provided they can demonstrate a commitment to industrial activity in Australia'. By 1991, and through all rounds to 2002, participation of international partners was assessed on the basis of 'benefit to Australia in some form'. In the 2004 and 2006 rounds, there were no specific requirements of international participants, and applications were assessed, among other things, on the 'strength of commitments by end-user participants, including through international collaborations'.

## **6.4 Summary**

Analysis of the objectives, selection criteria and guidelines reveals that the CRC Program has changed considerably since its inception nearly 20 years ago. While cooperative research is still the underlying *raison d'être* for the Program, the early ideals of enhancing and expanding the nation's overall scientific and technological research capability to support broadly stated national objectives have been replaced by a heavy emphasis on supporting end-user driven research which is capable of producing commercial return. While the early guidelines looked for a balance between strategic pre-competitive research and shorter-term research leading directly to application or commercialisation, the later guidelines placed an absolute focus on



**Table 3: Comparison of Selection Criteria**

1991-1996 rounds	2000-2002 rounds	2004-2006 rounds	2007 Defence round
<p>A Cooperative Arrangements</p> <ol style="list-style-type: none"> <li>The degree to which the Centre reflects a real commitment to build links between the participating research groups and organisations, and integrate and enhance their research activities</li> <li>The commitment of the participants to the Centre, and to the provision of adequate resources for it (inserted in 1992).</li> <li>The degree to which the Centre incorporates a strategy for developing international linkages with companies and research organisations that could prove substantial benefit to Australia, particularly the potential for commercial application of Australian research (inserted 1996).</li> </ol>	<p>Objective of the CRC</p> <ol style="list-style-type: none"> <li>The proposed CRC has well defined objectives that address a specific community and/or industry need</li> <li>The proposed outcomes of the CRC will make a significant contribution to Australia's sustainable economic and social development</li> </ol> <p>Collaborative Arrangements</p> <ol style="list-style-type: none"> <li>The collaborative arrangements reflect a strong commitment by participants to build links between the research groups and organisations, and between research groups and user and industry participants. The collaborative arrangements will integrate and enhance the CRC's research and educational programs. The proposed CRC is required to address the issue of international linkages and indicate how proposed linkages would contribute to the objectives of the CRC.</li> </ol>	<ol style="list-style-type: none"> <li>The outcomes will contribute substantially to Australia's industrial, commercial and economic growth.</li> <li>The collaboration has the capability to achieve the intended results.</li> </ol>	<ol style="list-style-type: none"> <li>Resources The proposed collaboration will marshal the appropriate participants and other resources necessary to achieve the proposed outcomes</li> </ol>
<p>B Research and Researchers</p> <ol style="list-style-type: none"> <li>The quality of the proposed research program, taking into account: <ul style="list-style-type: none"> <li>whether outcomes have been identified and are achievable;</li> <li>its feasibility as presented;</li> <li>the significance of the research and the likelihood of important advances.</li> </ul> </li> <li>The research capabilities of the Director and key researchers, and their commitment to the Centre in terms of their time and that of their support staff (inserted 1992).</li> </ol>	<p>Quality and relevance of the research program</p> <ol style="list-style-type: none"> <li>The proposed research program is of high quality and is well defined, with clear outputs that are achievable over the life of the CRC. The outputs are relevant to the stated objectives under selection criterion 1.</li> </ol>	<ol style="list-style-type: none"> <li>The collaboration has the capability to achieve the intended results.</li> </ol>	<ol style="list-style-type: none"> <li>Research The proposal will undertake quality research that addresses issues of significance to the future defence capability of Australia</li> </ol>
<p>C Application of the Research</p> <ol style="list-style-type: none"> <li>The realistic (inserted 1994) potential of the Centre's research program to lead to significant economic or social benefit to Australia. Degree to which the Centre addresses the needs of a sizeable sector of activity in Australia not adequately covered by existing CRCs (inserted 1994).</li> <li>The degree to which key user groups are integrated</li> </ol>	<p>Strategy for utilisation and commercialisation of research outputs</p> <ol style="list-style-type: none"> <li>The proposed CRC has a well structured, feasible and practicable strategy for the commercialisation, technology transfer or utilisation of the research outputs to achieve the proposed outcomes identified under selection criterion 2. The strategy should specifically address SME</li> </ol>	<ol style="list-style-type: none"> <li>The path to adoption (commercialisation/ utilisation) will achieve the identified outcomes.</li> <li>The funding sought will generate a return and represents good value for the taxpayer.</li> </ol>	<ol style="list-style-type: none"> <li>Results The outcomes from the proposed research, when implemented, will contribute substantially to developing Australia's defence capabilities and enhance Australia's industrial, commercial and</li> </ol>

1991-1996 rounds	2000-2002 rounds	2004-2006 rounds	2007 Defence round
<p>into the Centre as core participants, and are making substantial commitments of resources (inserted 1992).</p> <p>8. The existence of a well thought out and practical strategy for the utilisation or commercialisation of the research results (inserted 1992).</p>	<p>involvement in the CRC through direct or indirect participation and through involvement in the application of research outputs through commercialisation, technology transfer or utilisation, including where appropriate the spin-off of new SME companies. Milestones should be identified as a basis for performance monitoring.</p>		<p>academic abilities to support the Australian Defence Force</p>
<p>D Education and Training</p> <p>9. The development of leading innovative education and training activities that meet sectoral needs and enhance the employment prospects of graduates (inserted in 1996 to replace 'The existence of challenging educational programs which benefit from the overall size and orientation of the Centre, and address identified market needs' – inserted in 1992).</p> <p>10. The extent to which researchers from throughout the Centre are involved in education programs, particularly postgraduate programs.</p>	<p>Education and Training</p> <p>5. The proposed CRC has a well developed graduate education and training program oriented to research user and industry needs. The education and training program will demonstrably enhance the employment prospects and the value of the graduates of the program in the industry and user environment.</p>		<p>[Criterion 3 was intended to include education and training outcomes]</p>
<p>E Management and Budget</p> <p>11. The adequacy of the resources and budget for the proposed program.</p> <p>12. The adequacy of the management for the Centre, including the ability of the Director and key researchers to lead and manage research programs on the scale indicated.</p>	<p>Resources and Budget</p> <p>7. The budgeted resources, cash and in-kind support, including time allocation of key personnel, from all participants clearly demonstrate their commitment to the CRC and is adequate to support the proposed research and education programmes.</p> <p>Management structure</p> <p>8. The proposed CRC has an effective management structure, including financial, operational and research management arrangements, to ensure that the objectives of the CRC are realised.</p>	<p>3. <i>The collaboration has the capability to achieve the intended results.</i></p>	<p>^</p>
	<p>Performance evaluation</p> <p>9. The proposed CRC has a performance monitoring and evaluation strategy appropriate for the internal assessment of research and education programs, and for commercialisation, technology transfer or utilisation. The strategy will also meet the reporting requirements of the Commonwealth.</p>		

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commercialisation/utilisation of outcomes. This has been emphasised by more stringent requirements to demonstrate their IP management and commercialisation ‘vehicles’, with clear milestones and ‘paths to adoption’.

The early rounds required that the research itself be of high quality, but this has been less prominent in later rounds. While graduate education and training was a specified objective for the first years, specific reference to this was dropped from the objectives and the selection criteria in 2004 (though CRCs were still expected to have a PhD program). The early rounds recognised the cooperative aspect of CRCs, but the later rounds emphasised end-users over research providers, to the point of requiring that research providers not be in the majority on governing boards. Early CRCs were permitted considerable flexibility about their management and governance arrangements, so long as there were clear lines of responsibility and accountability linking the participants, but there has been a steadily increasing specification of requirements, and CRCs in the last 2 rounds have been required to be incorporated with independent chairs and the full governance strictures of corporate entities.

These trends are consistent with the drive over the last 20 years to derive financial returns from commercialisation of intellectual property arising from publicly supported research – the current program objective and guidelines provide a framework for commercialisation of research from CRCs. However the Review notes the findings of two economic-impact studies<sup>30</sup> of the CRC Program which have argued that while the economic impact of the Program has been considerable, it has been primarily through end-user application of research rather than direct commercialisation.

The changes in objectives and selection criteria make assessing the benefits and successes of the Program as a whole more difficult, as the evolving objectives change the bases for measuring success. It also makes interpretation of data about participant involvement in the Program problematical as discussed in the previous chapter.

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<sup>30</sup> Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia — Delivering Benefits for Australia*, A report for the Cooperative Research Centres Association Inc, December 2005; and Insight Economics 2006, *Economic Impact Study of the CRC Programme*, Prepared for the Department of Education, Science and Training, Insight Economics, Melbourne.

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## 7 The current Program reflected through submissions and consultations

### 7.1 Higher education sector

The consultations and submissions, and the evidence from recent rounds show there is a decreasing willingness by universities to participate in the CRC Program. The advantages to the sector have been slowly offset by the increasing perceived disadvantages. The main reasons given for this were quite consistent and recurring:

- the increased complexity of:
  - negotiating at the application/approval stage, including the requirement to incorporate, the difficulties in documenting IP management arrangements, and the expectations about the CRC lifespan, and
  - administering and managing the CRC. The more participants in the CRC, the more onerous and protracted the problems become
- the attractiveness of alternative schemes, most particularly ARC Linkage grants, which encourage quite flexible, outcome-oriented research partnerships involving fewer participants (although, by nature, they do not allow bigger challenges to be addressed as readily as a CRC can)
- the decreasing willingness to put in cash, given that universities see themselves as research providers, not research funders.
- the predominant role played by research-users, including mandatory control by research-users and/or independents of CRC boards, and the requirement that outcomes be strictly of economic or commercial application to those research-users
- the exclusion of outcomes which are predominantly public good
- the very strong emphasis on research in the sciences and engineering, which limits research in the social sciences, arts and humanities and therefore the services sector.

The Group of Eight universities, in particular, which between them have been core or other participants in nearly all CRCs and are still active in a majority of the currently operational CRCs, are increasingly reluctant to participate in new CRCs. In broad terms the Go8 universities agree with the Productivity Commission's analysis of and recommendations about the CRC Program. They prefer models such as the ARC Linkage scheme, where a more direct partnership with fewer partners is proving more flexible and practical.

Innovative Research Universities Australia, comprising five (at the time of submission) research-intensive universities, states quite bluntly:

*While the CRC program has been successful in broad terms, barriers to participation in the program have accumulated over time for various stakeholders and there is a risk that the longevity of the program and its associated established structures and practices will inhibit the potential for innovative responses within the existing program framework.<sup>31</sup>*

It calls for the CRC Program to be replaced with 'a coordinated suite of collaborative research programs, including networks modelled as the Canadian Networks of Centres of Excellence'.

The Australian Technology Network of Universities called for the establishment of a competitive grants scheme that funds multidisciplinary research on the potential for the idea to deliver real benefits to end users.<sup>32</sup> However individual submissions from members of this Network indicate support for retaining the CRC Program. One of its members, Queensland University of Technology (QUT), made the point that

*Cooperative Research Centres (CRCs) have made a substantial contribution to the innovation system in Australia. They have facilitated growth in areas of research crucial to the country's long-term viability, increased collaboration between research providers and end users and have contributed significantly to the training of 'work ready' [higher degree by research] students with skills attractive to a range of sectors. While QUT acknowledges the CRC model requires refinement, it supports the retention of the*

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<sup>31</sup> 95-Innovative Research Universities, p.20

<sup>32</sup> 321-Australian Technology Network, p.3

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*program and its funding. The current review of CRC program will hopefully address a number of deficiencies ... that have emerged in the governance and functioning of these centres.*<sup>33</sup>

## **7.2 CSIRO**

CSIRO, as by far the largest non-University publicly funded research agency in the country, has had significant involvement in CRCs, having been a participant in 122 of them. However, its enthusiasm for CRCs is waning in light of its increasing experience with other collaboration vehicles - most notably its own National Research Flagships - along with a shift in its research priorities 'towards large-scale projects addressing significant national challenges' with 'a strong focus on impact'. CSIRO shares the same concerns as the universities on issues such as complexity and lack of public good objectives. It also commented on the lack of 'robust termination conditions'.<sup>34</sup>

## **7.3 Industries**

There were surprisingly few submissions to the NIS Review from individual firms of any size which mentioned CRCs. There were more from industry bodies. Those that did submit had important issues to raise.

For example, GMHolden, which is one of the larger private sector cash contributors to the Program, through its involvement in the Auto CRC, believes that:

*The Auto CRC and the Manufacturing CRC have significant overlap and should be merged. The systems to run the CRCs are not shared in many instances. They appear to operate autonomously and compete for funds, resources and projects, creating significant waste in administering the CRCs. The CRCs could easily be reduced in number and be given a broader scope to cover a complete industry. The subsequent reduction in overhead could be directly added to the research budget.*<sup>35</sup>

Industry also had concerns about IP issues.

*... in almost every major discussion on the CRCs that has been held over the last 10 years, IP protection and ownership has been the major point of contention. The drive for CRCs to generate commercial income is steadily becoming a source of tension between many CRC organisations and their membership, putting additional pressure on IP considerations.*<sup>36</sup>

### **7.3.1 Industry groups**

The concerns expressed above tended to be echoed by industry peak bodies and representative groups. While acknowledging the broad successes of the scheme in encouraging R&D and collaboration, they also were critical of duplication, and of application costs. These groups were also more cognisant of the different needs of different industries, and did not think the current CRC model was sufficiently flexible to accommodate these differing needs.

More so, perhaps, than the research providers, the users expressed concern that some CRCs were moving towards becoming ongoing, government-subsidised, semi-commercial entities, potentially competing with the users they were originally intended to assist.

### **7.3.2 Individuals from industry**

Some senior individuals with significant industry experience provided submissions.

Dick Davies, CEO of AMIRA International Limited (1994-2004), and, before that, inaugural Executive Director of the GRDC (1991-1994) said:

*The Cooperative Research Centre program is about twenty years old and showing its age. Nevertheless it is a good concept which should be retained.*<sup>37</sup>

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<sup>33</sup> 424-Queensland University of Technology, p.2

<sup>34</sup> 217-CSIRO, p.32

<sup>35</sup> 509-GMHolden, p.33

<sup>36</sup> 259-Boeing Australia 1, p.17

<sup>37</sup> 77-Dick Davies, p.4

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He went on to suggest a range of changes, including increasing the funding, reducing compliance and transaction costs, changing the rules for CRC renewals, widening the commercialisation/utilisation criteria, and modifying the board structure.

On the other hand, Dr Robert Watts, Chief Scientist and Vice-President Technology for BHP Billiton (1997-2003), with experience of 8-10 CRCs, said:

*My experience with the CRC program has been largely negative. Over the period 1997 to 2003 I was involved through my position with BHP in trying to extract value from investments in 8-10 Centres. With one, possibly two, exceptions it was extremely difficult to achieve many positive outcomes.*<sup>38</sup>

His criticisms centred on the lack of recognition by researchers of various commercial imperatives, and unrealistic expectations about IP ownership and licensing.

He contrasted this with his direct experience of ARC CoEs and Linkage grants, including as Chair of recent CoE selection and reviewing rounds. He said these two programs had a greater focus on academic excellence and the generation of revolutionary rather than evolutionary technologies and should be encouraged.<sup>39</sup>

## 7.4 Government agencies

While Government agencies are considerable contributors to a number of CRCs – especially in the agricultural arena – by and large they did not make detailed comments on the CRC Program through the submission process. Those that did however made some pertinent comments, particularly on the difficulties of aligning government program priorities with researcher-led and other user-led priorities.

As the Department of Environment, Water, Heritage and the Arts (DEWHA) has said, *none of [the Commonwealth-funded] research programs ... readily address the needs of both researchers and policy professionals in part because of the differences between pure and applied science which often work to very different time lines and different reward systems. This can lead to a mis-match of expectations between researchers and funding agencies and a breakdown in cooperation and collaboration.*

It further added:

*while CRCs have met some of the needs for public good environmental research, the model also poses some problems – the research centres become politically active when funding support is withdrawn and allocated to other priorities; the requirement for co-investment can generate perverse outcomes for the Australian Government because first-order research priorities are not necessarily addressed if they are not also priorities for co-investors; the participating research institutions often ‘rebadge’ existing research programs rather than genuinely shift in research to address the real priorities.*<sup>40</sup>

A pertinent comment on the involvement of public sector agencies in collaborative research programs more generally was made by the Chief Executive of the CSIRO, Dr Geoff Garrett, in a personal capacity. He stated that:

*In my experience, the intensity of the leverage (or ‘coinvestment’) game – and how it is played – is quite peculiar to Australia. It often corrupts ‘proper’ collaboration, and distorts the system. Moreover, it is frequently federal government funding seeking to leverage federal (or state) government funding from a different pot. It’s very silly.*

He described leverage as ‘the dead cat on the table’.<sup>41</sup>

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<sup>38</sup> 56-Robert Watts, p.1

<sup>39</sup> *ibid*, p.2

<sup>40</sup> 607-DEWHA, p.3

<sup>41</sup> 655-Geoff Garrett, p.8



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## 7.5 The Learned Academies

The Academies also had pertinent comments.

The Academy of Science said:

*The CRC program has developed into an essential part of Australia's R&D program for establishing critical mass through collaboration between complementary research groups and collaboration with industry partners. However there are a number of initiatives which could be considered to improve innovation outcomes from CRCs. These include a review of the intellectual property guidelines for concept development and commercialisation of research arising from CRCs.*

*The Academy agrees strongly with the Government that public good should be reintroduced into the range of activities by which a CRC is assessed. The CRC system should increase its scientific, commercial and financial flexibility so that overlapping but distinct criteria could operate for different situations, although a component should always include a strategy to claim technological leverage and sustainable employment.<sup>42</sup>*

The Australian Academy of Technological Sciences and Engineering (ATSE) said:

*The CRC Program is valuable and should be retained. The Program has achieved excellent outcomes and has helped to improve research management in Australia.<sup>43</sup>*

and then went on to recommend a range of changes that reflect those suggested by research providers and industry above.

The Academy of the Humanities argued that the arts and the humanities should be given a more prominent role in contributing to innovation in the CRC Program.<sup>44</sup>

## 7.6 Major Funding bodies

### 7.6.1 ARC and NHMRC

The ARC pointed out the range of its own collaboratively focused programs and their complementary nature to the CRC Program. It indicated it was

*considering the further expansion of Linkage Projects in ways that would enable more strategic partnerships to be developed with end-users, and consistent with the Productivity Commission's finding on the subject<sup>45</sup>.*

The NHMRC also emphasised the importance of collaboration, particularly international collaborations which, it says,

*are vitally important as the provision of Australian health and medical research expertise to developing countries in our immediate region has the potential to positively impact on domestic health outcomes<sup>46</sup>.*

### 7.6.2 CRC Committee

The CRC Committee, which is responsible for the CRC Program, strongly endorsed it:

*We recognise that the CRC Program creates strongly polarised views – with harsh critics and strong supporters. We note that similar points can be made about any public or private organisation or institution, and we have chosen to be constructive about other parts of Australia's innovation system. Improvements to the CRC Program can and should be made, but the Committee believes the Program makes one of the strongest – and most rigorously measured – contributions to Australia's economy and innovation system.<sup>47</sup>*

It made a number of considered recommendations for improvements to the Program, some of which have been adopted by this Review, and some not.

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<sup>42</sup> 415-Australian Academy of Science, p.6

<sup>43</sup> 567-Australian Academy of Technological Sciences and Engineering, p.12

<sup>44</sup> 269-Australian Academy of the Humanities, p.17

<sup>45</sup> 576-Australian Research Council, p.8

<sup>46</sup> 271(R), NHMRC, p.5

<sup>47</sup> 212-CRC Committee, p.4

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The CRC Committee's submission included details of the biennial review in 2007 of the selection round guidelines, including a summary of the feedback from consultations. A common comment related to the cost and complexity of establishing CRCs, as well as the onerous reporting requirements.

The CRC Committee was in favour of maintaining the Program, pointing out that

*A key factor in the design of CRCs as they have evolved is their focus on the end-user. This is a 'demand-pull' program as distinct from the 'technology-push' that is a natural focus for a university or other PFRA.<sup>48</sup>*

## **7.7 CRCs themselves**

### **7.7.1 CRCs**

Only 21 of the current CRCs made submissions to the NIS Review. On the whole they were generally supportive of the Program, though the complexity of the application and management process was frequently commented on. There was a trend towards supporting:

- the reinstatement of public good outcomes
- redressing the declining amount of Government funding for the Program in real terms and
- introducing more flexibility to the Program's timeframe by extending the overall timeframe but reducing the up-front commitment required.

### **7.7.2 CRC Association**

The CRC Association, whose role is to provide a 'national, coordinated voice for its member CRCs on all major issues affecting them in pursuit of their research objectives and in the conduct of the CRC Program'<sup>49</sup>, provided 11 recommendations for enhancement of the CRC Program. They particularly supported a renewed focus

*on the beneficial application of innovation for Australia, and it should be acknowledged that this will involve generation of pure public benefits, private benefits and, more often, a complex blend of both.<sup>50</sup>*

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<sup>48</sup> *ibid*, p.26

<sup>49</sup> From <http://www.crca.asn.au>

<sup>50</sup> 320-CRC Association, p.12



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## 8 Understanding what is driving partners' satisfaction & dissatisfaction with CRCs

Submissions, and more particularly consultations, indicated there is a complex set of issues underlying the support for the CRC Program and concerns that various participant groups have with it. Some of these issues are to do with the Program itself; some are due to factors extrinsic to the Program.

### 8.1 End-users

Research end-users can derive significant benefits from CRC involvement. The starting odds are good: for every dollar contributed in cash and in kind by end-users, over \$1.50 in cash and in kind is contributed by the Commonwealth (through CRC Program funding), research providers and others (e.g. State Governments).

For companies, involvement can produce a range of benefits: it can be a good way to keep up to date with latest technological developments; to have an informal source of ready advice on R&D matters; and to influence the development of some needed technology. This particularly applies to firms with no in-house R&D capacity, including many SMEs.

*ROI is very important to SMEs, of course. But we must recognise that there are different drivers for different companies at different times and in different situations. Sometimes the most valuable ROI comes not in cash terms, but in the form of networks, alliances and partnerships, up-skilling and technology awareness.<sup>51</sup>*

When there are only a small number of end-users, they will by definition be major contributors, and able to exert decisive influence on the CRC's R&D program, thus, in some cases, effectively using the CRC to expand their in-house R&D capacity without the in-house cost.

End-users often maximise their position strategically at the time of CRC bids, making joining conditional on guaranteed access to certain intellectual property and to a range of outputs. There has perhaps been less of a joint-venture approach and more one of staking a claim to outputs in return for inputs.

If the end-user engagement has been well handled, CRC participation can be very rewarding indeed. In a presentation to CRCA08, Jo Staines, General Manager, Program Management Office, Hawker de Havilland (HdH), explained how the CRC for Composite Structures, a third-term CRC of which HdH was a founding member in 1991, had been vital to HdH winning a major parts contract with its US parent, Boeing. In her presentation she said:

*Why the CRC structure appeals:*

- Access to public sector R&D capability*
- Risk share – access to a greater body of R&D than company would fund internally and a wider range of projects/technologies*
- Access to R&D critical mass*
- Learning experience for our personnel*
- A strong education program*

*The CRC structure allowed us to cast our net widely, across a variety of composite technologies, at time when we were looking to redefine our competitive edge.*

*Sandwich composite manufacture was mature, we couldn't compete on price, we needed a 'new' technical edge*

*The CRC structure allowed us to have our fingers in a whole lot of R&D pies – concurrently, we did not need to pick a winner early in the process*

*This CRC excelled at turning the technology into applications – demonstrators. We had something that our employees, leaders and customers could touch and feel ...*

But she noted some limitations:

- *Company's business/R&D cycle – members needs will change over the course of time, maybe even cyclical*

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<sup>51</sup> Interview with Peter Woodgate, CEO of the CRC for Spatial Information (CRCSI) after CRCSI won the 2007 Star Award for Small Business Engagement by the CRC Association for its 43pl SME consortium: <https://www.crc.gov.au/Information>

- *Intellectual property ownership – if it is integral to our business we want to control it*
- *Policy direction to commercialise ‘CRC technology’ is usually at odds with the interests of the industry members*
- *Serving many masters – compromises made on project content, schedule.*<sup>52</sup>

For industry end-users, even involvement in predominantly public good CRCs can be beneficial. *Much ‘public good’ research has commercialisation potential when considered in the broad sense of the word. For example, the Antarctic Climate & Ecosystems (ACE) CRC has developed science and IP that is of interest to the shipping industry and insurance companies – a fact not originally obvious, or of relevance, to the researchers themselves, who considered themselves as serving the public good.*<sup>53</sup>

Several well-structured end-user groups saw CRCs’ potential early on. Examples include the various rural RDCs which saw the opportunity for leveraging additional Commonwealth funds to support their programs, took advantage of this, and ensured they were represented on, if not able to control, the CRC boards of which they were part. Likewise, State primary industry departments, which were already used to high levels of collaboration in agricultural research, saw the leveraging possibilities, as did mining companies used to brokering research and development alliances through AMIRA International.

## 8.2 Research providers

Initially the CRC Program was supported strongly by universities and CSIRO – both drove many of the early bids.

### 8.2.1 CSIRO

CSIRO was strategic from the start. It used its size as leverage, and rarely went in as a bit player. For a research organisation with a focus on translational research, CRCs were a ‘natural’ vehicle, with their mandatory end-users. CSIRO generally did not offer cash as part of its contribution, but invested in kind. These in-kind contributions were often effectively tied, through the provision of the headquarters and the CEO. CSIRO also insisted on a realistic multiplier on in-kind salaries.

Despite this strategic approach, CSIRO now says:

*Interest in initiating new CRCs, or in extending existing CRCs into a third round, is flagging both within CSIRO, and also with our research partners. This is driven by a number of factors:*

- *Our participation in other research vehicles, both within and outside CSIRO, over the past decade has given us a wealth of experience that reveals more attractive models in both commercial and public good areas (such as research consortia, JVs, Flagships).*
- *Our research priorities have shifted our investments towards large-scale projects addressing significant national challenges through the National Research Flagships program. These require us to direct and realign major research effort towards a big goal with a strong focus on impact. Our collaborations are becoming much more top-down, purposeful ones (for example through the Flagship Collaboration Fund) rather than the bottom-up, self assembling that characterises most CRC bids.*
- *Participation in new CRCs is becoming increasingly unattractive because of issues of complexity (see Section 3 and above): fragmentation of effort in multiple CRCs competing in the same domain (e.g. biosecurity); leverage issues; complicated IP rights management negotiation; lack of robust termination conditions; diversity of governance models; excessive governance arrangements and reporting requirements relative to scale of operation.*

*As a consequence, we believe that the CRC program should not continue in its current form.*<sup>54</sup>

<sup>52</sup> Presentation at CRCA08, May 2008, Sydney, *How Hawker de Havilland won the contract to supply parts to Boeing for the 787 as a consequence of HdH involvement with the CRC for Advanced Composite Structures*, by Jo Staines, General Manager, Program Management Office, Hawker de Havilland

<sup>53</sup> 91-Australian Institute for Commercialisation, p.5

<sup>54</sup> 217-CSIRO, p.32

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## 8.2.2 Universities

Through most of the life of the CRC Program, universities competed fiercely to be involved in CRCs. At the time of its introduction, the CRC Program was the largest research grants program available to Australian universities. Funding for each CRC lasted for seven years; there was considerable prestige associated with 'winning a CRC bid'; and the CRCs were a good source of PhD scholarships and assistance with PhD supervision. Furthermore, the early 1990s was a time of great optimism that universities could build wealth from commercialisation of research results. So CRCs were worth competing for. Universities worked hard on CRC bids, investing time and funds in their preparation, and pledging quite large amounts of cash as well as in-kind contributions. In many ways they competed more fiercely with each other than with other research providers such as CSIRO. Research end-users realised this and understandably played on the situation to maximise contributions from universities to bids.

Involvement in CRCs also made particular strategic sense for universities. Some reasons for this include:

- rounding out a strong research collaboration portfolio in a particular area e.g. for a time the University of Queensland's Department of Computer Science was a core partner in and provided the headquarters simultaneously for a Key Centre for Teaching and Research, a Special Research Centre and a CRC. There are several other cases like this.
- where strong collaborations already existed either with end-users or end-user representative bodies. This was especially so where there were strong links between university agricultural and science faculties and rural RDCs; and between engineering and science faculties and mining companies often working through AMIRA.
- where involvement made sense from the point of view of a dominant local industry. Thus the University of Adelaide and Charles Sturt University were founding partners of the CRC for Viticulture and that CRC was headquartered on the Waite Campus of the University of Adelaide. And Deakin University, headquartered in Geelong, has been a core partner in automobile-related CRCs such as CRC for CAST Metals Manufacturing, CAST Cooperative Research Centre and CRC for Advanced Automotive Technology.
- where universities had relevant faculties that were strong in teaching but relatively weak in research. Thus Griffith University and Victoria University are core partners of the CRC for Sustainable Tourism.
- where a university was building its research profile from a relatively low base. Southern Cross University, a newer university which ranked 30<sup>th</sup> out of 38 in total research earnings in 2006 in the Australian higher education sector, has been particularly strategic in this regard. It has been involved in eight CRCs as a core participant and five as a support participant, and invested \$7 million dollars in cash and \$54 million in-kind.

Over time universities developed a better understanding of the true benefits and costs of involvement in CRCs. They realised that cash contributions could use up a high proportion of the discretionary research budget (generally managed by the Deputy Vice-Chancellor (Research) or equivalent) leaving relatively little for all the other claims on it. This was particularly so in the research-intensive universities which by the mid-1990s had tied up a lot of resources in the CRC Program. For example, by 1996 the University of NSW was in 16 CRCs. And the resources were tied up for a long time – seven years.

In-kind contributions were a source of particular angst. Often promised generously to secure the bid, they were increasingly hard to deliver, especially as they were sometimes not explicitly provided for in universities' departmental and faculty budgets.

Also, as time went on, it became clear that returns from commercialisation of CRC research were unlikely to be large.

The decision not to allow research providers to form a majority on CRC boards and then the move to mandatory incorporation made the situation more difficult still. By being involved in CRCs, universities were relinquishing control of substantial resources, a matter that led to criticism from governing bodies and auditors. It also sometimes led to human resource management tensions – both for universities and the CRCs' management – over accountability for staff given as in-kind contributions.

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### 8.2.3 Research providers do deals

In order to ensure they did not lose on their investment in CRCs, research providers increasingly made their agreement to join CRC bids conditional on various factors. Sometimes the deal concerned the rate by which overheads on in-kind would be calculated (a standardised method was not introduced until the 2004 round). Sometimes they insisted that the CRC guarantee to return to the research provider more cash than the sum of the total cash and in kind being supplied by that research provider. (This led to many CRCs turning into grant-giving bodies with research providers bidding for research funds from the CRC with the understanding that over the life of the CRC the bids had to cover the deals with the various research providers.) Sometimes the research providers insisted that the headquarters or a large node be located on their campus and rent either paid or factored in as in kind. Sometimes the deal involved tying expenditure of contributions to a local node. These arrangements were often reinforced by further deals with State Governments which made their cash contributions conditional on the cash being spent in their State. Like the deals done by end-users for access to IP and outputs, these behaviours demonstrated less of a joint-venture approach, and more one of staking a claim.

### 8.3 Deals can be challenging for CRC management

The research provider deals and conditions, along with the industry deals and conditions, have meant that the board and management of a CRC have often been required to meet a complex set of agreements (not all of which are formally recorded) which curtail their freedom to operate as an independent entity. With the introduction of compulsory incorporation, the tension associated with this has increased. CRC Boards are increasingly unwilling to honour non-recorded deals but ignoring them leads to the risk of the research provider or end-user leaving the CRC or refusing to be a partner in a later round. It is important to note that, while this can look very odd post hoc, it is easy to see how it occurs. It's a highly understandable anti-collaborative but not illegal practice.

Put simply, there are two predominant ways to view CRCs: as end-user focused research joint ventures in which the collaborating parties work together to a purpose which is mutually beneficial with resources they contribute themselves and with some help from the Commonwealth through the CRC Program; or as independent research organisations focusing on research commercialisation and adoption and funded by public and private sector partners and the Commonwealth through the CRC Program. In recent years the Program has favoured the latter model. The Review suggests that it is time to move back towards the former.

### 8.4 External factors have affected research providers' attitudes to CRCs

Research providers' decisions to pull back from CRCs are unlikely to have been affected by changes to the CRC Program alone. The research funding environment for CSIRO and universities is very different now to that in 1991.

#### 8.4.1 Changes in CSIRO

CSIRO has moved from the Division and Industry Institute structure it had in 1991 to a matrix structure in 1996 and then in 2001 to

*a hybrid structure put in its place, which was focused on large cross-divisional national flagship projects. There were extensive changes in management structures and in personnel and an accompanying change in research strategy—away from responsiveness to industry demands and towards national research objectives/flagships.*<sup>55</sup>

#### 8.4.2 Changes in higher education

Over the 20 years to 2006 the Australian higher education sector expanded greatly with total student enrolments growing from 390,000 to 985,000<sup>56</sup>; research higher degree enrolments growing from 13,900 to 48,200; but the proportion of the Commonwealth's contribution to higher education revenue dropping from 83% to 41%<sup>57</sup>. Student to staff ratios increased from

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<sup>55</sup> from G. Upstill & T. H. Spurling, *New Structures, New Strategies: CSIRO's Changing Role in Australian Innovation*, Prometheus, Vol. 26, No. 2, June 2008

<sup>56</sup> see [http://www.go8.edu.au/storage/go8statements/2007/Go8\\_Backgrounder\\_No1\\_1007.pdf](http://www.go8.edu.au/storage/go8statements/2007/Go8_Backgrounder_No1_1007.pdf)

<sup>57</sup> From *Go8 Backgrounder 1*, October 2007, Group of Eight



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14.3 to 20.9<sup>58</sup> between 1990 and 2005 and accountability increased with significantly increased reporting requirements. Despite the heavier average teaching loads and the financial pressures on universities, the research system expanded significantly with expenditure on research in higher education growing from \$0.8 billion in 1992 to \$3.9 billion in 2004<sup>59</sup>. Over this same period total direct research income to universities has risen from \$0.2 billion to \$1.4 billion<sup>60</sup>. As a consequence, with their resources spread ever thinner, universities are increasingly selective about their research investments.

One of the great stresses in the higher education system is that research income does not match research expenditure. In 2004 Australian universities spent \$3.9 billion on research but the total direct research income was only \$1.4 billion with universities having to find the difference from general university funds. Part of the problem is the issue of lack of full-funding for national competitive grants – for these funding schemes universities have to cover the bulk of the costs of chief investigators' salaries and overheads plus most of the infrastructure associated with a National Competitive Grant. They do it because the National Competitive Grants are highly competitive, carry great prestige to the individual researcher and the institution, and are vital to building and maintaining university brands which are essential for attracting extra income (most notably from full-fee paying foreign students) as Commonwealth support for domestic student places has dropped.

The CRC Program is not counted in the National Competitive Grants – rather it is a full-funded program in the sense that the partners to a CRC agree to meet all the costs, apart from the CRC Program grant, among themselves. But in both cases (NCGs and CRCs) the money has to come from somewhere. As with the NCGs, universities have to invest heavily in CRCs to get a return and that return (if it comes) is generally not net cash but rather money for specific research or education projects. With incorporated CRCs becoming the norm and their boards becoming less willing to honour deals done at the time of a CRC's establishment, universities have less confidence than previously about the likely returns on their investment. With this and with high transaction costs, investments in the NCGs look increasingly attractive, despite the lack of full-funding disincentive.

A university can be certain of what it is getting with an NCG. And the size and length are increasingly appealing: ARC Discovery and Linkage grants have become larger and longer on average over the last 5-6 years. Many NCGs have developed features that were originally highlights of the CRC Program. Universities are finding that they can work well with CSIRO through the Flagship partnerships, and they can respond to industry needs using the Linkage grants. CRCs are in many cases becoming a second choice. An unfortunate consequence is that the best researchers (because they are the very ones who succeed in the NCGs) are now increasingly not in the CRC Program.

In summary, over recent years, CRCs have become less attractive to research providers generally and to CSIRO and the research-intensive universities particularly for reasons that are influenced partly by changes to the Program and partly by the external environment.

## **8.5 Participant data reflects claims with regard to some participants**

Industry's general satisfaction with the CRC Program is reflected in an increase in the 2006 round over the previous few rounds in its contributions (both directly and through industry associations) on a per CRC basis.

By any measure, CSIRO involvement in the CRC Program is lessening. In the last round only five of the successful CRCs had CSIRO as a partner (in all previous rounds it was involved in nine or more); and its total pledged contribution in that round was \$32 million (all in kind), its lowest contribution ever, whereas its pledged contribution in the previous four rounds had been over \$100 million per round.

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<sup>58</sup> Universities Australia, 1990 to 2005 at <http://www.universitiesaustralia.edu.au>

<sup>59</sup> 81110DO001\_2006 Research and Experimental Development, Higher Education Organisations, Australia, 2006 available on [www.abs.gov.au](http://www.abs.gov.au), constant 2006 prices, CPI 'Education' specific index with 1989-00 as the base year.

<sup>60</sup> Universities Australia, Statistics Collection, HERDC Time Series 1992-2005, constant 2006 prices, CPI 'Education' specific index with 1989-00 as the base year.

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The situation is less clear with universities. In absolute amounts, universities contributed less than in the last two rounds than they had in the previous three. But these reductions need to be considered in the light of the smaller number of CRCs in the last two rounds and the change to the in-kind valuation at the 2004 round.

The change in university contribution is most noticeable for the research-intensive Go8 universities which pledged only \$4 million in cash in the 2006 round, down from over \$20 million in each of the previous four rounds. Their total contribution in the 2006 round was \$74 million whereas it had been over \$100 million in each of the previous four rounds. Even allowing for the lower number of CRCs funded in the 2006 round than had been funded in the previous few rounds, this indicates a decline in contributions.

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## 9 Comments against evaluation principles

In May 2008 the Minister asked the Review to evaluate the CRC Program against the principles of appropriateness, effectiveness, efficiency, integration, performance assessment and strategic policy alignment.

### 9.1 Appropriateness

#### Appropriateness

The principle of Appropriateness goes to whether the Program fills a gap left by the market as a result of market failure or through social inequity.

The CRC Program primarily fills a gap left by the market as a result of market failure. Professor Slatyer said he devised the CRC Program to address four fundamental challenges to research and innovation for Australia:

*Our combined scientific and technological resources were quite substantial but they were dispersed both geographically and institutionally. This separation made it difficult to build strong research teams. It also led to unnecessary duplication of facilities, and difficulty in ensuring that they were world class.*

*Existing funding arrangements contributed to this problem. Most research funding in Australia is from institutional sources and flows down from management through administrative channels to operational units and individual researchers.*

*Corporate R&D was not well developed in most Australian industry sectors so there was a limited capacity for corporate and other research users to benefit fully from the skills and information in the Universities and government research organisations. As we all know, information and technology are transferred most effectively when there is a similar level of knowledge in both parties, so the lack of in-house R&D capability was an important liability.*

*Graduate programs in Australian Universities still provided mainly traditional academic training, involving research only and a single supervisor. This did not prepare students well for jobs outside the academic world. It also denied students access to the skills and experience of many of Australia's best researchers and denied those researchers the stimulus of interaction with students.<sup>61</sup>*

The Program has certainly contributed substantially to addressing these challenges. As noted above, over the life of the Program to date 168 CRCs (102 if renewed or new-from-existing are not counted separately) have been created bringing together teams focused on end-user issues. Many CRCs address research areas never considered as research fields previously: their names alone tell a great story. CRCs have operated with partners from across a range of disciplines and sectors who are indeed dispersed geographically and institutionally. All CRCs have nodes in four or more locations and, in fact, no CRC has only a single node.

Partners have been willing to contribute substantial resources (in kind and in cash - some tied; some untied) to make the centres work. The leverage on the Commonwealth's investment through this Program is substantial especially from public sector research providers (universities and CSIRO). The contributions from industry and other public sector agencies are more modest given their size, but still significant. The total investment by the Commonwealth is of the order of \$3 billion, with almost \$9 billion (in kind and in cash – tied and untied) leveraged from participants - including approximately \$2.9 billion from universities; \$2.3 billion from industry; \$1.6 billion from government end-users; and \$1.1 billion from CSIRO.

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<sup>61</sup> Ralph Slatyer, "Cooperative Research Centres: A retrospective view", Annual Meeting of the CRC Association, May 2000 (<http://www.crca.asn.au/activities/2000/Slatyer>)

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### 9.1.1 Influence on other programs to address market gap

The CRC Program's success also seems to have influenced the design of several other programs which, on certain points, have possibly been even more effective at addressing the challenges Professor Slatyer outlined. The ARC Centres of Excellence Program introduced in 2003 differed from the Special Research Centre Program it replaced with its emphasis, like the CRC Program, on encouraging the involvement of research end-users, where appropriate. The Centres of Excellence have proved particularly effective at pulling together world-class teams several of which have attracted strong industry support and are providing direct research results for industry. For example:

*Centre for mine automation to be established - 9 July 2007. Rio Tinto has announced major funding for one of the world's largest civilian robotics research centres, a centre for mining automation, which will be based at The University of Sydney. The centre for mine automation, which will be led by Professor Hugh Durrant-Whyte, will be based at the University's Australian Centre for Field Robotics (ACFR) with the aim of developing and implementing the vision of fully autonomous and remotely operated mining processes. ...Rio Tinto's Head of Technology and Innovation, Dr Grant Thorne said: "By developing technology, research and training in mine automation, Rio Tinto expects to add value to its existing mine operations, to deliver a long term competitive advantage, and to increase knowledge of new systems within the Group's operations."... The ACFR is the lead partner in the Australian Research Council (ARC) Centre of Excellence for Autonomous Systems, hosts the Defence Science and Technology Organisation (DSTO) Centre of Expertise for Uninhabited and Autonomous Systems, and is a partner in the Cooperative Research Centre (CRC) Mining. Professor Hugh Durrant-Whyte is an ARC Federation Fellow.<sup>62</sup>*

### 9.1.2 Addressing social inequity issues

A perhaps unexpected aspect of the CRC Program has been its sponsoring of some very innovative collaborations addressing social inequity. Two such examples are the CRC for Aboriginal Health and the Desert Knowledge CRC.

*The CRC for Aboriginal Health is a virtual organisation that brings together the Aboriginal health sector, government health agencies and research institutions to ensure that research conducted into Aboriginal health:*

- *is driven by priorities set by Aboriginal people themselves;*
- *is of practical use and transferred expeditiously in an accessible form to the Aboriginal health sector; and*
- *results in the development of research capacity within the Aboriginal community itself.*

*The CRC for Aboriginal Health is governed by an Aboriginal-majority board with representation from all its core partners.<sup>63</sup>*

The Review notes that a CRC proposal like this would have been regarded as uncompetitive in later rounds, unless it could demonstrate economic benefits, given the removal of public good as one of the objectives of the CRC Program.

### 9.1.3 Is the CRC Program really distinct from other programs in the NIS?

The CRC Program occupies a unique niche in the range of research programs in the NIS with its emphasis on forming relatively large research centres which bring research providers from the public sector together with private sector end-users to work on end-user problems. By contrast, CSIRO's National Research Flagships focus on national challenges and are primarily driven by CSIRO research capabilities although with strong collaborative input from across the NIS. ARC Linkage Grants, on the other hand, tend to be predominantly bilateral collaborations between a research provider and an end-user with a problem to solve. That said, these three programs form a most useful complementary set of end-user-outcomes-focused research programs.

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<sup>62</sup> See <http://www.usyd.edu.au/news/84.html?newsstoryid=1811>

<sup>63</sup> See <http://www.crcah.org.au/aboutus/whoware.html>

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The other program that has some similarities to the CRC Program is the Centres of Excellence Program. The difference here is that the Centres of Excellence are research-area focused rather than being focused on end-user-inspired research although, as pointed out above, they are encouraged to involve end-users where appropriate, again providing another form of complementarity with the CRC Program.

Table 4 on the next page provides an overview of the differences between the various programs.

#### **9.1.4 The CRC Program should be national**

Another element of the appropriateness principle is whether the activity is undertaken by the most appropriate level of Australian government. The CRC Program is appropriate as a national program – as noted above CRCs have successfully pulled together research expertise from across the country. It should be noted however that State Governments have been important players both in the CRCs directly, contributing about \$1.2 billion to CRCs in cash and in kind, and through support for the preparation of bids, particularly those with headquarters (for preference) or nodes in their States.

### **9.2 Effectiveness**

The Minister also asked the Review to consider whether the CRC Program represents value for taxpayer funds, and whether it has achieved its stated objectives.

The CRC Committee, in its submission, told the Review that it believes the CRC Program makes one of the strongest, publicly funded contributions to Australia's economy and innovation system and had delivered excellent return from the investment of taxpayer funds:

*In particular, the CRC Program has contributed to, and can continue to create, what a highly experienced innovator on the CRC Committee calls the 'alchemy of growth'<sup>64</sup>.*

The attachment to its submission contains 40 snapshots of 'the many tremendous outcomes' of the CRC Program.

There are various ways of measuring outcomes and impacts of a research funding scheme. The amount of funding leveraged from participants, discussed in an earlier section is one measure. But there are others. For example, two recent studies have been commissioned into the economic outcomes of the CRC Program. Both tell good stories.

#### **9.2.1 Direct economic benefit**

The first study, by Allen Consulting, found

*The key finding from the modelling of the delivered impact of the CRC Programme is that over the 1992 to 2010 period the Australian economy's overall performance has been considerably enhanced when compared to the performance that would have occurred in the absence of the funding for round one to seven CRCs that was provided between 1992 and 2005.<sup>65</sup>*

It went on to give 25 examples of 'key identified sources of *delivered* and *verified* benefits from CRCs to date'<sup>66</sup>. Only a few are included here:

*CRC Welded Structures. In 2004 the CRC proved that a \$30 million solution for a defence shipbuilder was a viable alternative to the \$150 million solution that was going to be used. This allowed a saving of \$120 million in costs to be achieved.*

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<sup>64</sup> 212-CRC Committee, p.4

<sup>65</sup> Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia — Delivering Benefits for Australia*, A report for the Cooperative Research Centres Association Inc, 2005, p.39

<sup>66</sup> *ibid*, p.16

**Table 4: CRC Program compared with CSIRO National Research Flagships, ARC Linkage Grants and ARC Centres of Excellence**

	CSIRO National Research Flagships	Cooperative Research Centres	Linkage Projects	ARC Centres of Excellence
Commenced	2003	1991	1991	2003 (current ARC CoE) 1982 (original Centres of Excellence, later SRCs)
Objectives	The National Research Flagships assemble multidisciplinary teams from across the national innovation system to address Australia's major challenges and opportunities.	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.	To encourage and develop long-term strategic research alliances between higher education institutions and partner organisations + others	To undertake highly innovative research at the forefront of developments within areas of national importance, with a scale and a focus leading to outstanding international and national recognition + others
Number (in existence)	9	56 (2008)	1659 new and ongoing projects (2007)	36 (2008)
Number (per selection round)	NA – CSIRO determines number and area	7 new; 3 new-from-existing; 4 supplementaries (2006)	425 (2007)	11 (2005)
Duration		Most are 7 years but new from existing can go up to 21 years	Min: 1 year Max: 5 years	Min: 5 years Max: 8 years
Funding (Commonwealth)	\$480m by 2004-2011 spread over all flagships; av. \$7.5m per centre p.a. \$114.5m of the \$480m has been allocated to enhance and reinforce the development of collaborative partnerships which reflect the National Research Priorities.	From \$1.5m per year - \$7.0m per year; av. \$4m per CRC per annum	Min: \$30k per year Max: \$0.5m per year; more in exceptional circumstances	Up to \$5m per annum
Average number of partners	Each flagship seeks to engage many (> 30) collaborators	7-9 per CRC	2 per grant	Variable; usually more than 2 per Centre
Focus	National research priorities	Program, thematic	Project, thematic	Program, thematic
Frequency of call	N/A	Two years	Six months	Subject to budget availability
Success rate	N/A	17% (2006), 18% (2004); higher for new-from-existing	40%-50%	10%
Disciplines	Currently water, energy, climate, oceans, health, food, light metals, minerals, manufacturing	The 2006 CRC guidelines stated that 'There is no restriction but every CRC must include some research in the natural sciences or engineering'.	All discipline groups (except clinical medicine and dentistry)	All discipline groups (except clinical medicine and dentistry)
Eligibility	N/A	CRC proposals must include a private sector participant (defined in the guidelines as an entity that does not derive the majority of its revenue from government) and one Australian higher education institution.	LP proposals must involve an eligible higher education institution and a collaborating organisation (eg. private sector, private non-profit or Government agency).	ARC Centres of Excellence proposals must involve an eligible higher education institution.



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*CRC for Cattle and Meat Quality. Gross revenue from the sale of CRC developed products (vaccines and gene marker tests) by commercialisation partners (Pfizer Vaccine Animal Health, Intervet Australia Pty Ltd and Genetic Solutions Pty Ltd) between 2001 and 2005 has totalled \$6 million.*

*CRC for Polymers. Gross revenue of \$16.6 million between 2004 and 2005 has been generated from sales by commercialisation partners (Olex and Orica) of CRC research based polymer cable products (Pyrolex Ceramifiable™ and cellular cable insulation and sheathing materials). Around \$11 million of these sales represents import replacement activity.*

*CRC for Asthma and Airways. Application of CRC research on inhaled corticosteroids has led to changed prescribing patterns leading to a \$6 million per annum saving in Commonwealth Government drugs expenditure from 2005 onwards.*

This report referred to the difficulty of quantifying economic benefit, and referred to 10 examples of 'likely significant delivered economic benefits' from the CRC Program<sup>67</sup>. These included:

*CRC for Soil and Land Management – improving productivity of Sodic [sodium-affected] Soils*

*CRC Mining – commercialisation of Tight Radius Drilling technology*

*CRC for Aquaculture – improved environmental management of prawn farming*

*CRC for Sustainable Rice Production – more efficient rice production*

A second study in 2006 by Insight Economics<sup>68</sup> used a different counterfactual from that employed by Allen Consulting. It found that the economic impact was even greater.

Insight Economics provided three examples of 'impacts that CRCs have generated via the direct commercialisation of knowledge':<sup>69</sup>

*Capital Markets CRC: Capital Markets Surveillance Services*

*CRC for Sensor Signal and Information Processing: GroundProbe*

*CRC for Tropical Plant Protection: developing 'super fodders'.*

These two studies were considered in detail by the Productivity Commission which reported:

*Additionality issues were also canvassed in two recent evaluations of the CRC program. The key finding of the first, by Allen Consulting was that the delivered (as opposed to prospective) program benefits cumulatively increased GDP by 60 cents for every dollar of direct public funding. The study required that the benefits put forward by the CRCs to be included in the modelling must have been unlikely to have occurred in the absence of the CRC 'in the timeframe under consideration'. More recently, Insight Economics (2006) estimated an economic impact almost twice as great as the earlier study with a cumulative increase in economywide output of \$1.16 for every dollar invested in the CRC program.*

*The main reason for the much higher magnitude of benefits compared with the earlier study was due to the identification and quantification of a number of additional delivered benefits.*

The Commission revisited both studies and, after substituting assumptions that it believed had more validity, provided different estimates.

*In this case, the Commission estimates that a better indication of the value of the CRC program, based on the raw results of the Insight Economics evaluation, is 51 cents of consumption benefits per dollar of CRC grant funds ... The Allen Consulting study ...using the same adjustment approach as for Insight Economics yields an adjusted net increase in real consumption of \$0.10 per dollar of grant expenditures. (Productivity Commission Appendix I, p. 682)*

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<sup>67</sup> *ibid*, pp.24-29

<sup>68</sup> Insight Economics, *Economic Impact Study of the CRC Programme*, Prepared for the Department of Education, Science and Training, October 2006

<sup>69</sup> *ibid*, pp.12-15



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After consulting the economists on the Review Panel for the Review of the National Innovation System along with Professor Alan Hughes, an international advisor to that Review, this Review sees no need to differ from the Productivity Commission on this issue but notes the sensitivity of the models used to derive these estimates to the assumptions on which the models are based and, accordingly, cautions against too much credence being placed on precise estimates here. At best the calculations provide confidence that the CRC Program does provide a positive return on taxpayers' funds invested.

### 9.2.2 Impact of application

Both Allen Consulting and Insight Economics commented that the most significant quantifiable benefits were those delivered through the end-user *application* of research rather than direct commercialisation.

In Insight Economics' words:

*The application of CRC generated knowledge by means other than direct commercialisation is likely to be the channel whereby the greatest economic, environmental and social impacts from the CRC Programme are delivered. Application based impacts include specific impacts such as the:*

- *uptake of new knowledge, products or processes developed through CRCs that have improved end users' economic performance. Improved performance may involve things such as cost savings in production processes or increased output from a given level of inputs (i.e. efficiency gains);*
- *cases where CRC research has allowed risks to be avoided or mitigated against by end users of the research*
- *uptake of new knowledge, products or processes developed through CRC research that has reduced pressures on the government budget in areas such as health, social security and defence spending;*
- *application of CRC research to reduce the environmental impacts associated with industry (including agricultural) production activity; and*
- *application of CRC research to beneficially impact on human health outcomes.<sup>70</sup>*

It provided 9 examples of CRCs successfully applying knowledge, including:

*Cotton Catchment Communities CRC: managing pests and improving water efficiency*

*CRC for Welded Structures: cost reductions for industry*

*Australian Sheep Industry CRC: parasite management and precision production<sup>71</sup>.*

And provided further examples of CRCs that had generated benefits to which it was difficult to attach a market value, including:

- *Desert Knowledge CRC ... increasing skills, employment and information [which] has encouraged the valuing of Indigenous knowledge, language and culture*
- *CRC for Antarctic Climate & Ecosystems' sea ice modelling ... better understanding of the implications of climate variability and its impact on sea levels and biodiversity.*

### 9.2.3 Research contract income

Another measure of impact is the research contracts the CRCs have attracted as detailed in the table below.

CRCs are also increasing their income from licensing, spinoffs and from education short courses.

However the Review has noted that contract research involving partners can be problematic. As the Queensland University of Technology commented:

*some industry partners try to run projects that are more suited to a straight contract research arrangement via a CRC to take advantage of leveraged funds. This works against the collaborative spirit of centres and creates unnecessary complications in IP negotiations.<sup>72</sup>*

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<sup>70</sup> *ibid*, p.16

<sup>71</sup> *ibid.*, p.16-23

<sup>72</sup> 424-Queensland University of Technology, p.3

**Table 5: Income from CRC research contracts**

Year	Number of CRCs	Number of contracts	Income (\$'000)	Average (per CRC) Income (\$'000)
1992-93	33	93	10,317	313
1993-94	49	316	19,318	394
1994-95	51	380	23,479	460
1995-96	61	576	33,815	554
1996-97	56	690	42,891	766
1997-98	62	713	55,932	902
1998-99	51	662	46,672	915
1999-00	49	517	45,409	927
2000-01	53	468	38,152	720
2001-02	62	515	50,262	811
2002-03	61	512	53,571	878
2003-04	72	488	47,237	656
2004-05	69	629	53,100	770
2005-06	69	584	61,677	894
2006-07	55	611	53,191	967

### 9.2.4 Other impact measures

Insight Economics' report provided some examples of the benefits of CRCs through access to international knowledge networks and through skills formation through research student training.

In respect of researcher education, Allen Consulting reported that:

*The productivity premium associated with the extra postgraduate degree holders in industry from the CRCs can be estimated to be worth in the order of \$6.5 million per annum to the Australian economy.<sup>73</sup>*

Research quality measures can be useful in assessing the impact of research funding programs. However in this case there was no formal data available. While the CRC Program collects annual statistics on research publications, it does not collect concomitant research quality and impact data. It should be noted however that several CRCs collect such data themselves and have used it as part of their 3<sup>rd</sup> year review presentations.

### 9.2.5 Has the CRC Program achieved its stated Objective?

The current objective is:

*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.*

As indicated above, it is hard to produce a precise quantitative estimate of how much the CRCs have enhanced Australia economic growth, especially net economic growth. But as the Productivity Commission points out:

*In a different context, recent OECD evaluations of partnership programs have noted that additionality has an important behavioural dimension. This refers to the desire to create long-lasting linkages between researchers and research users to ensure persistent beneficial effects .... The CRC selection criteria specifically reflect this aspiration in calling for strategies to maintain the benefits of the CRC once Commonwealth funding has ceased. This was expected to result from either the generation of sufficient revenue from licensing or other commercial activities (contracting) as a substitute for program funding, formation of 'start-up' companies based on the intellectual property generated*

<sup>73</sup> Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia — Delivering Benefits for Australia*, A report for the Cooperative Research Centres Association Inc, 2005, p.30

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*by the CRC or an injection of resources from commercial partners to allow a continuation of the cooperative venture.*

In other words, the contribution to 'industrial, commercial and economic growth' might come through the long-lasting linkages. The Commission goes on to argue, in the case of the CRCs, that:

*In practice, however, there is very little evidence supporting the attainment of this objective. Over the life of the program, revenue streams generated via licensing and royalty arrangements have been quite modest, examples of company 'spin-offs' are rare and examples of CRCs continuing operation successfully outside the CRC structure beyond the funding period are even rarer. In fact, most CRCs have sought repeat funding support for at least a second seven year duration (to pursue new research proposals) with some now in a third phase.*

However there are exceptions. The CRC for Water Quality and Treatment which completed in June 2008 has

*... been succeeded by Water Quality Research Australia Limited (WQRA), a national not-for-profit scientific research institution. WQRA will develop and undertake a program of research and education to build on the achievements of the CRC.<sup>74</sup> A total of 42 organisations are current members of WQRA (21 Industry Members, 14 Research Members and 7 General Members).<sup>75</sup>*

Another example comes in the area of Photonics. Many of the core members of the Photonics CRC have had a long-lasting linkage, a linkage that received support from the ARC Large Grants and Collaborative Grants as well as the CRC Program. More recently many of the group are participants in CUDOS (ARC Centre of Excellence for Ultrahigh-bandwidth Devices for Optical Systems) which, in turn, has strong links to NICTA.

On the question of whether or not the CRCs have achieved 'high levels of outcomes in adoption and commercialisation', the Productivity Commission's analysis is clear, as indicated in the quote above, that high levels of commercialisation have not happened. However the Allen Consulting (2005) and Insight Economics (2006) studies provide good examples of commercialisation and adoption in individual CRCs as do many submissions from the CRCs themselves. The Allen Consulting Report said:

*Most benefits from the CRC Programme have come from industry application of research rather than through narrowly defined 'commercialisation' events such as spin-off company formation and licensing of IP.<sup>76</sup>*

End-user views were mixed. The GRDC has been a major investor in the Program, investing \$79 million.

*The key objective of the GRDC is to invest in R&D that will enable Australian grain growers to effectively compete in global grain markets. The CRCs have been one of the vehicles available to the GRDC of delivering its output in outcomes to the grains industry and the wider community.<sup>77</sup>*

Others are less convinced.

*While the CRC model is a great initiative of the Federal Government, the use of the current model as a vehicle for innovation and to take ideas to market should be reviewed in the food arena. [George Weston Foods'] participation in CRCs over a period of 13 years has not delivered the normal business expectations of return on investment. GWF's observation of having competing companies in the one CRC makes it impossible to commercialise any IP. In our experience, we had to take highly innovative projects out of the CRC and set up a separate contract with the CRC to manage the further development of this IP. Although contracting the CRC to do the research work was successful, this model of engaging an external research provider to carry out the work is similar to other contract research projects GWF currently has with universities and*

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<sup>74</sup> See <http://www.waterquality.crc.org.au/>

<sup>75</sup> See [http://www.waterquality.org.au/WQRA\\_members.htm](http://www.waterquality.org.au/WQRA_members.htm)

<sup>76</sup> Allen Consulting, 2005, p.40

<sup>77</sup> 641-GRDC, p.4

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research organisations. In this model, GWF is able to manage timeframes and scope, and steer the project deliverables towards a commercial outcome at a reduced cost.<sup>78</sup>

### 9.2.6 But is the current Objective appropriate?

The Productivity Commission also raised the question of the appropriateness of the current objective of the CRC Program:

*The complete shift to industry-focused CRCs is inappropriate. In addition, current cost-sharing arrangements do not appear to reflect the distribution of benefits from the program, with potentially large subsidies available to business partners.<sup>79</sup>*

This Review agrees that the current objective is not suitable, a matter that is addressed in greater detail in the next chapter.

## 9.3 Efficiency

In looking at the efficiency of delivery of the CRC Program, the reviewers were cognisant of the oft-stated complaints about the high costs associated with planning, bidding for and establishing new CRCs, the ongoing governance and transaction costs, the perceived intrusive and inflexible administrative requirements and the level of reporting given the size and nature of the centres. The Review suggests that considerable efficiencies could be gained from more flexibility in the Program's design, particularly in the governance arrangements, length of term, and ability to add participants. Recommendation 3 addresses this matter.

The Productivity Commission's report quoted Melbourne Ventures Pty Ltd (the University of Melbourne's technology commercialisation company) as noting that:

*... its involvement in the 2004/05 round (in which it was involved with 4 successful applications, although it ultimately only participated in 3 CRCs) took more than 900 hours of negotiation of complex, voluminous legal documents which if outsourced would have cost in the order of \$0.75M.<sup>80</sup>*

And the CRC Association stated:

*Linked to risk aversion is the ever-increasing cost of transactions and legals within the CRC Program. Every dollar spent on the negotiation and renegotiation of contracts is a dollar that is not spent on innovation. This is also a disincentive to the participation of SMEs in the Program.<sup>81</sup>*

The Review agrees and notes that the complex rules regulating the conduct of CRCs are a high burden on the Commonwealth resources supporting the Program as well as on the participants in CRCs and CRC bids themselves.

In terms of efficiency, the Review notes that the CRC Committee has had many members over the years with significant research management experience. However, while the Review is in no way critical of any individuals, it notes the Secretariat supporting the Committee contains little experience with high-level research administration and past experience managing research teams. Having senior managers with such experience, as used by the ARC and its sister body the National Science Foundation in the USA, would provide better guidance on program design and could lead to increased efficiencies in assessing program data metrics and in selection and reviewing. Recommendation 7 addresses this matter.

## 9.4 Integration

Integration goes to whether government agencies are working together to deliver on measure objectives within clearly defined lines of responsibility.

The Review believes that greater integration with agencies offering related programs would greatly benefit the Program, in both program-design quality and operating efficiencies, and would provide better articulation between programs that form a 'spectrum' in the National Innovation System. The new NHMRC Partnerships for Better Health Projects, the ARC Linkage Grants, the CRCs and the CSIRO Flagships form such a spectrum of end-user oriented research

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<sup>78</sup> 538-George Weston Foods, p.6

<sup>79</sup> Productivity Commission Research Report, *Public Support for Science and Innovation*, p.371

<sup>80</sup> *ibid.*, p.457

<sup>81</sup> 320-CRC Association, p.10

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grants of increasing size and complexity. There are also program design relationships between the CRC Program and Innovation Australia Programs, DEWHA's Commonwealth Environmental Research Fund Program, the ARC Centres of Excellence Program and NHMRC Program Grants. The review acknowledges that coordination of all Commonwealth science and technology programs exists at a high level through the Commonwealth Coordinating Committee on Science and Technology but more operational integration is needed – largely common application forms, common performance metrics as much as possible, and common high quality assessor databases.

On another aspect of integration, the Review notes the strong involvement throughout the life of the CRC Program of organisations such as the rural RDCs. Some of the most successful CRCs are those in the Agricultural and Rural-based Manufacturing Sector. This sector has 15 active rural RDCs, established under the Primary Industries and Energy Research and Development Act 1989, covering virtually all the agricultural industries. Their role is to bring researchers and the industry together 'to establish research and development strategic directions and to fund projects that provide industry with the innovation and productivity tools to compete in global markets'<sup>82</sup>. They are, of course, funding agencies in their own right; they are also active participants in the CRCs from this sector. It is arguable that the RDCs are so well developed that they could (and do) themselves broker the type of arrangements that CRCs do. The CRC Program gives them an opportunity to leverage additional moneys from the Commonwealth, over and above those already contributed directly by the Commonwealth and through the levy on farmers. It is arguable that the funds allocated to the CRCs in this sector could be at least as productive, if not more so, if they were allocated with the direct involvement of the RDCs.

Similarly there are many CRCs in the environmental area and there is a case for better integration with the relevant policy Department. (This also could apply to the Health portfolio). DEWHA noted in its submission:

*Much environmental research is designed to produce information to support public policy development and is funded under a range of models. This includes: major funding agencies such as the Australian Research Council and the National Health and Medical Research Council; targeted research programs such as Cooperative Research Centres... None of these research programs, however, readily addresses the needs of both researchers and policy professionals in part because of the differences between pure and applied science which often work to very different time lines and different reward systems. This can lead to a mismatch of expectations between researchers and funding agencies and a breakdown in cooperation and collaboration.<sup>83</sup>*

## 9.5 Performance Assessment

Performance Assessment goes to ensuring that the measure being reviewed has robust reporting and measurement tools in place.

The CRC Program has a formidable system of reporting and reviewing including annual reports along with a structured annual questionnaire - the Management Data Questionnaire (MDQ) - and qualified audited statements about the CRC's contracted budget; a major third-year review; and a requirement to lodge a Commercialisation and Utilisation Plan. Until recently it also had a Visitor Program.

The Review noted that, through these processes, comprehensive data on individual CRCs is collected. Also compliance monitoring against each CRC's agreement with the Commonwealth is thorough.

However on the reporting tools in place, a number of submissions commented on the onerous reporting burdens associated with CRCs, which suggest that the required reporting is excessive rather than robust.

The Review was concerned for other reasons that the reviewing processes might not be adequately robust. It notes with concern that while many success stories were offered about CRCs, there appears to be only a limited formal process for dealing with and reporting in

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<sup>82</sup> [http:// www.ruralrdc.com.au](http://www.ruralrdc.com.au)

<sup>83</sup> 607-DEWHA, p.3

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aggregate on serious issues arising from CRC reviews and annual reports and that only one CRC had its funding terminated following a poor review (and that was actually a decision of the CRC to close after considering the review results). This statistic indicates that the Program either has a low-risk approach to selection (inappropriate in a program emphasising impact-making research); is not asking the right questions; is not using review processes that will highlight problems; and/or is unwilling to be tough enough in dealing with failure. For example, the third-year review process is very complex with substantial emphasis on internal review in the lead up to the visit by the expert review panel, but as that panel (and in particular its Chair) is largely nominated by the CRC being reviewed there is a possibility that problems might not be adequately highlighted in the final review report although it is acknowledged that the review membership must comply with Commonwealth guidelines and that the Commonwealth may seek changes if it has concerns about independence.

From discussion with CRC Committee members it is clear that the Committee has been aware of problems and has addressed them through processes such as refining the guidelines between rounds and through direct discussions with CRCs where it has concerns. The Review believes that a more forthright approach is needed.

The Productivity Commission noted

*Despite the requirements on CRC participants to report against the achievement of research milestones on an annual basis, there is a risk that 'marginal' projects may continue even when beneficial outcomes are unlikely because of inappropriate program incentives. This is especially significant given the duration of the funding agreements and because CRC participants have more information regarding likely research outcomes than the program administrator and an understandable interest in maintaining funding continuity. In addition, although the program administrator has the power to intervene in the CRCs activities, it may be reluctant to do so because it will highlight a failure in the approval processes used to select successful participants.<sup>84</sup>*

This issue is addressed in Recommendation 7.

## **9.6 Strategic Policy Alignment**

Strategic Policy Alignment addresses whether the measure or measures are consistent with the government's long-term policy priorities, including sustained economic growth, productivity and participation.

The Review finds that the CRC Program is consistent with the government's long-term policy priorities for innovation driving economic growth.

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<sup>84</sup> Productivity Commission Research Report, *Public Support for Science and Innovation*, p.455





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## 10 The future

The CRC Program needs to be a program which ‘works’ for all those funding it and participating in it. It needs to be an appropriate, efficient and effective investment of Government funds; it needs to be a program that end-users know will produce research that allows rapid breakthrough business transformation; and a program that attracts and stimulates the very best researchers from research provider institutions. For all parties the organisational and funding arrangements need to work smoothly but in a manner that is consistent with prudential requirements.

As noted above, the Review believes it is time to move CRCs back to being end-user focused research joint ventures in which the collaborating parties work together to a purpose which is mutually beneficial with resources they contribute themselves, with some help from the Commonwealth, rather than as independent research organisations focusing on research commercialisation and adoption and funded by public and private sector partners and the Commonwealth.

### 10.1 Continuation of the CRC Program

The complaints about the Program from consultations, workshops and submissions were remarkably consistent. The main differences were in the approach to a solution. No one suggested that the Commonwealth should stop providing incentives for research collaborations between researchers from the universities and PFRAs on the one hand and industry and public and community sector users on the other. The biggest point of difference was on whether the CRC Program should continue as is, or continue in a refreshed and revived format, or whether its program funding should be rolled into other Commonwealth programs – most notably the ARC Linkage Grants Scheme – which also support collaborative research. Some advocates for this latter approach referred to the Productivity Commission’s finding that a complement to the CRC Program that supports ‘smaller, shorter and more flexible arrangements between groups of firms either independently or in conjunction with universities and public sector research agencies’ be piloted through an enhancement of the ARC Linkage Program.

There is no doubt that the existing CRC Program is losing significant support from the big public-sector research providers (and others). Innovative Research Universities stated that *While the CRC program has been successful in broad terms, barriers to participation in the program have accumulated over time for various stakeholders and there is a risk that the longevity of the program and its associated established structures and practices will inhibit the potential for innovative responses within the existing program framework.*<sup>85</sup>

As Dick Davies says

*There is anecdotal evidence from the last round that top scientists are avoiding the CRC process, finding other sources of funding easier to access.*<sup>86</sup>

Nor does the CRC seem of strong interest to the majority of Australian firms. The Review considered recommending that the Program in its current form be terminated, and the funds from this and other collaborative schemes be rolled into another collaborative program.

However, informed by the wide range of issues confronting the NIS Review Panel, the CRC Program Review believes there is still a need for a program supporting big, end-user-inspired and driven, risk-addressing research projects directed at significant national issues (and outcomes) across Australia’s innovation system.

Though the smaller ARC Linkage grants do provide simpler collaborative relationships, they are not large enough to tackle the major national issues confronting Australia’s industries and public sector service providers in the same way that a CRC can.

Such projects, almost inevitably, require often complex collaborations in some form, and it can be argued that a Government-funded incentive can make them happen sooner and more efficiently. As Queensland’s Chief Scientist says:

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<sup>85</sup> 95 Innovative Research Universities, p.20

<sup>86</sup> 77-Dick Davies, p.3

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*As a nation of just 20 million people, we need to collaborate rather than compete. We need to set about building bridges rather than barriers between researchers, between organisations, between sectors and between nations. We need to agree on common goals, set clear strategic directions and focus on areas where we are not only excellent, but also capable of making a difference. And we need to build a supply chain of innovation and entrepreneurship that takes us all the way from quality curiosity-driven research to the development of innovative products and services.<sup>87</sup>*

The Review considers it prudent to continue to invest in a CRC-style scheme, provided its objectives are re-focused, the problematic aspects of the Program raised in submissions and consultations are addressed, and a comprehensive evaluation is conducted before too long to determine whether the rejuvenation has succeeded.

**Recommendation 1.1:** That

- i. a re-focused and modified CRC Program continue, and
- ii. the next evaluation recommend whether the Program continue in light of the modifications and the impact of changes arising from the Innovation White Paper.

Unless some extra funding is injected into the Program the next round will be able to fund only a small number of centres. This could exacerbate the unease with aspects of the Program.

In particular the next round could see a 'spike' in applications as many existing CRCs are likely to apply to be new CRCs. This review also recommends the reinstatement of public good as an objective of the Program (see Recommendation 2) and this will further increase the number of applications in future rounds.

More frequent opportunities to submit applications for CRCs are desirable. This will allow innovators to react quickly to emerging priorities and keep up with the increasing pace of global developments. It also has the potential to increase the overall standard of applications, as innovators can take the time required to put bids together knowing that if they miss one year's round they can be in time for the next. In a world that is moving very fast, this is desirable. The Review acknowledges there are budgetary implications for administering the Program annually, but commends increased frequency as a means of providing greater opportunity and flexibility for groups to address challenges as they arise.

These challenges are many and varied and require varying timeframes and levels of funding to suit. The Review therefore recommends greater flexibility in duration and funding to encourage greater diversity and opportunities for groups such as SMEs to draw benefit from the program.

**Recommendation 1.2:** That

- i. funding be injected into the Program to allow for annual rounds to take place over the next five years;
- ii. there be a selection round at least once a year so that emerging market failure/creation and urgent public good issues can be addressed quickly; and
- iii. the Program encourage CRCs of varying lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), with funding up to a maximum of \$45M over the life of the Centre.

## 10.2 Objectives

The first major modification required is to the objectives of the CRC Program. As the CRC Committee has said:

*It is important to recognise that the evolution of the Program objective is critical to ensuring it adapts to changing needs. It has now been some five years since major change was introduced and it is now timely to evaluate that change and identify further adaptations necessary to ensure the Program continues to meet critical need.<sup>88</sup>*

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<sup>87</sup> 431-Peter Andrews, p.3

<sup>88</sup> 212-CRC Committee, p.25

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The current CRC Program objective:

*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*

is worthy, but raises problems discussed below.

### **10.2.1 Market failure**

How do we know that the Program funding is genuinely assisting industries to address market failure and is not funding research that would have been funded by end-users anyway? In other words, is the funding distorting the market? The Productivity Commission argued that the emphasis on commercial outcomes was less defensible from an economic efficiency perspective and more likely to result in research collaborations of a type that a firm or industry collective would undertake anyway. It said that this 'increased the risk of providing support to projects with low potential spillovers and those that would be undertaken in the absence of public subsidies'<sup>89</sup>.

### **10.2.2 Capacity for commercialisation**

CRCs typically appear not to have the know-how and resources to be good at commercialisation. The Productivity Commission found that very few CRCs generated sufficient commercial returns, despite the emphasis on commercialisation, to operate successfully beyond the funding period. It recommended that a greater emphasis be placed on translating research outputs into economic, social and environmental benefits. In other words, the emphasis should be on end-user uptake rather than commercialisation by the CRC itself.

In the words of the Chief Scientist, Dr Jim Peacock<sup>90</sup>:

*Cutting edge research does not, at first, always lead to commercialisation. Some of the best research being conducted in the world today in epigenetics, mathematical and earth sciences and medicine, for example, are not focussed on commercialisation. They do, however, have the potential to provide huge economic benefits. Limiting the CRCs' focus to a single outcome area, such as direct commercialisation, prevents Australia's world class researchers from obtaining funding and, more importantly, entering into cooperative agreements which include market perspectives and which can then be developed with other support systems.*

*The level of government and industry support for CRCs should also be determined by the field of expertise and the state of development within that area. In addition, the closer a CRC is to a commercialised product, the higher proportion of industry support it should have.*

It is also not clear why industry partners (and under the current guidelines they are primarily industry, not public sector) need a separate entity, i.e. a CRC or separate CRC commercialisation company, to undertake the commercialisation – by and large, they should be able to do it and be responsible for doing it themselves. As Boeing noted in its submission:

*The philosophy of the CRCs seems to have gravitated toward doing research as a business rather than focusing on maturing a capability to the point industry can effectively and affordably commercialise the results. For instance, in the case of the CRC-ACS<sup>91</sup>, we have found that its major drive is to develop into a commercial business that is self-funding. This has caused significant issues for Boeing over the past two or three years. We have not been able to get reasonably mature technology out of the CRC to impact our business without a significant product development cost.*

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<sup>89</sup> Productivity Commission Research Report, *Public Support for Science and Innovation*, p.450

<sup>90</sup> From *Chief Scientist's response to the Minister's question on the Cooperative Research Centres (CRC)*, 11 February 2008, provided to the Review

<sup>91</sup> CRC for Advanced Composite Structures (or Composites CRC)

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*The real question here is, should ... a Collaborative Research Centre ... be formed to address a specific research issue moving it from a concept to a prototype and then be disbanded when the commercialisation member takes over the maturation process?*<sup>92</sup>

This argument does not just apply to large enterprises (LEs) which clearly have significant commercialisation capacity. For SMEs, the input requests and expectations need to be tailored to their size, i.e. the outcomes likely to assist them need to be proportional to their capacity to implement them. A similar argument applies to the outcomes from public good CRCs. The partners commissioning the research – hospitals, State departments, public sector agencies etc – need to accept responsibility for applying or implementing the outcomes.

### **10.2.3 How long should CRCs last?**

There have been various incentives for CRCs to be self-perpetuating. The original vision of Professor Slatyer was that the CRCs would become self-sufficient, and cease to be funded under the CRC Program. Realistically, however, self-sufficiency has proven to be out of reach, and there has been a potential for CRC energies to be diverted from the main game:

*The primary role as a facilitator of interaction between universities and industry has been superseded to some degree by pressure to commercialise the results of research and by the related need to try to become independent, self-sustaining entities following the cessation of Commonwealth funding. CRCs now devote a significant proportion of their resources and energy to strategies that have the entity's post-government funding survival as the primary goal.*<sup>93</sup>

The easiest way for CRCs to continue their existence has been through re-bidding. This trend was pointed out in a number of submissions, and is evidenced by the number of CRCs making 3<sup>rd</sup> and even 4<sup>th</sup> bids. Their competitiveness remains strong, as they know the CRC system and their previous experience makes them mature collaborators compared with newer collaborations. A further effect, noted by the CRC Committee, is that

*The continued funding of existing CRCs also limits new CRCs entering the scheme, particularly in new and emerging areas. ... Prima facie, current practice limits innovation by allowing domination by established players.*<sup>94</sup>

DEWHA noted in its submission that:

*the research centres become politically active when funding support is withdrawn*<sup>95</sup>.

The hopes for self-sufficiency were based in part on the hopes held across the university and PFRA sector 20 years ago that commercialisation of IP would be a much needed boost to offset declining levels of Government funding: in much the same way that the export of education was seen as a means of supporting the teaching side of university activities. While the latter has been successful beyond expectation, the commercialisation of IP has not. The Australian experience mirrors overseas experience.

As the Productivity Commission has noted, CRCs are not good at commercialisation. Nor are they earning enough money from other sources such as consulting (though several of them earn quite a lot from this source) to be fully self-sustaining, as Table 5 shows. Boeing commented that:

*CRCs have gravitated to undertake research activities for hire and often are not the most efficient organisations for certain types of research charging far more for their work than it would cost if it were contracted out to a dedicated R&D organisation like CSIRO.*<sup>96</sup>

Incorporation of itself has also impacted on CRCs' potential longevity. As Professor Marilyn Sleigh, a member of the CRC Committee, noted:

*Some CRCs are now behaving as government-subsidised semi-commercial entities, aiming to eventually generate income for themselves and become self sustaining. This development is possibly reinforced by the requirement for incorporation of CRCs, and*

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<sup>92</sup> 259-Boeing Australia 1, p.17

<sup>93</sup> 419-University of Queensland, p.3

<sup>94</sup> 212-CRC Committee, p.31

<sup>95</sup> 607-DEWHA, p.4

<sup>96</sup> 259-Boeing Australia 1, p.17

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*the appointment of commercially constructed boards, unless these boards are provided with clear guidance on program requirements on flow of benefits. It appears somewhat at odds with the original goals of the program and has accidentally set up a situation where a CRC (having greater financial power than most early stage companies) may actually be competing with companies, particularly SMEs, it might be expected to assist.*<sup>97</sup>

Many staff employed by or in CRCs also have an interest in keeping employed, and are inclined to encourage the perpetuation of their own CRC.

These factors all reduce the incentive for a CRC to complete its tasks and then wind up or transition proactively into the industry or industry sector, or another non-CRC entity, using the successes of the CRC research program to make the case. The Review believes this is not the best way for this whole Program to run. Joint ventures are primarily about coming together for a mutually beneficial objective with an end-point in sight, and that approach should underpin the modified CRC Program.

Other impacts of continuous funding are that it 'minimises the ability of a "cornerstone" innovation program to be agile'<sup>98</sup> and 'limits innovation by allowing domination by established players'<sup>99</sup>.

#### **10.2.4 Reinstatement of public-good CRCs**

Reinstatement of CRCs collaborating on projects aimed at public good was in the current Government's election promises; several largely public-good CRCs have been cited as some of the best CRCs to date; and most current CRCs include an element of public good despite their required focus on commercial activities. There was widespread support in the submissions for reinstatement of public good as a CRC objective.

The Productivity Commission expressed concern that public support for social and environmental research activity had been reduced, given their potential impacts, their fundamental role as an input to public policy, and increasing Australia's preparedness to deal with social and environmental issues. It said:

*There are two strong rationales for public funding support of science and innovation. The first reason is that governments exercise many functions, and need to fund R&D to discharge those functions effectively.*<sup>100</sup>

Specifically on CRCs, the Review refers to the Productivity Commission's finding 10.14 that

- *the original objectives of the program – the translation of research outputs into economic, social and environmental benefits – should be reinstated. This is likely to produce greater community benefits than focusing public support on the commercialisation of industrial research; and*
- *the share of public funding should be aligned to the level of induced social subsidy to business collaborators.*<sup>101</sup>

The Review strongly endorses this finding, and supports Minister Carr's statement in February 2008 that:

*we need to shift away from the overriding emphasis on short-term commercialisation that has prevailed over the last decade. It is time we started thinking strategically. ... Many of the benefits that we expect to accrue from innovation are economic, but that is not the only yardstick. We must have the courage to think long-term.*<sup>102</sup>

It has included public-good in its recommendation below on the new objectives of the CRC Program.

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<sup>97</sup> 168-Merilyn Sleight, p.9

<sup>98</sup> 667(L)- Defence Science and Technology Organisation, p.4

<sup>99</sup> 212-CRC Committee, p.31

<sup>100</sup> Productivity Commission Research Report, *Public Support for Science and Innovation*, p.53

<sup>101</sup> *ibid.*, p.455

<sup>102</sup> Australian R&D Review, February 2008



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### 10.2.5 Collaborating to a purpose

The inherent problems of CRCs referred to above could be overcome if the CRCs were required to focus very specifically on research collaborations aimed at ameliorating a clearly identified risk (e.g. an intractable public-good problem or a significant market failure or limitation) the solution to which would provide a significant advantage – not necessarily commercial – for CRC end users, preferably with significant spillovers.

Without an exact problem to be solved, it is difficult to decide whether the research is potentially valuable: either to end-users, or to the national benefit.

There would be maximum benefit from Commonwealth funding if CRCs were put together to solve a research problem, pass the findings on to end-users as efficiently as possible, then wind up. If the collaborative approach is not making sufficient progress on solving the problem, then winding up would also be expected. In other words, the focus of the research should be at the pre-competitive or, in the case of public-good CRCs, pre-applicative stage.

The focus must still be on end-users. As the chairman of the Australian Seafood CRC has said<sup>103</sup>, it is important to establish this focus from the outset (though it is essential to ensure a balance of end-users and the ‘best’ researchers and to get the dynamics right).

End-users could come from the public as well as private and community sectors, in line with the reinstatement of public good as a legitimate objective. However, to avoid such collaborations double dipping on Government funds, applications would need to be carefully scrutinised during the application process.

As the Australian Technology Network of Universities recommends (albeit suggesting a new competitive grant scheme to achieve this) multidisciplinary research should be funded *on the potential for the idea to deliver real benefits to end users.*<sup>104</sup>

The emphasis on a single purpose will also help avoid the tendency by CRCs to become an end in themselves. International best practice suggests that CRC-style centres are typically one-shot centres since they have come together for the particular purpose of solving a specific problem.<sup>105</sup>

In respect of CRCs in the agricultural sector, one submission stated that they should be focused *away from sustaining themselves as institutions, and towards delivering benefits to industry and the public, utilising public resources in areas where definable gaps exist between the portfolios of the research organisations and RRDCs.*<sup>106</sup>

The original aim of the Program to encourage closer working links between the private sector and Australia’s public-sector researchers would still be important but would be secondary to the new primary aim of collaborating to solve a major challenge with a potential significant impact.

This follows from the fact that over the last 20 years Australia has become increasingly sophisticated in its NIS funding schemes in encouraging collaboration among and between different groups (researchers, industry, public-sector and community end-users) within the NIS, but has lost sight of the essential purpose of such collaboration.

#### **Recommendation 2:** That

- i. the prime objective of the CRC Program be to provide support for pre-competitive or pre-applicative research ventures between end-users and researchers which tackle a clearly-articulated, major challenge for the end users addressing identified risk gaps such as:
  - a significant challenge in creation of a new industry area; or
  - a significant challenge in an existing industry sector where the risk involved in

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<sup>103</sup> Peter Dundas-Smith, *Start as you intend to operate!*, presentation to CRCA08 conference, available at <http://www.crca.asn.au>

<sup>104</sup> 321-Australian Technology Network, p.8

<sup>105</sup> The Review consulted representatives of international public research collaboration programs in the US, Canada, Ireland, the EU and the UK for this report.

<sup>106</sup> 167-Dr Gregory Harper, scientist with Meat and Livestock Australia on leave without pay from CSIRO, writing in a private capacity.

- solving the challenge is too great for a single firm to tackle alone; or
- a significant challenge in the provision of public goods and services; or
- a significant challenge in an area of community or social benefit (and not restricted to an area represented by government portfolios).

The solution to the challenge should be innovative and of high impact and capable of being deployed rapidly by the end-users to good effect. Each CRC should be of high national benefit with significant spillovers.

- ii. a secondary aim of the Program be to encourage closer working ties between Australia's public-sector research organisations (universities and PFRA's) and end-user groups and to encourage end-user-focused education, especially at the PhD level.

Several existing and past CRCs would fit in well with this new objective:

- CRC for Aboriginal Health is an example of a CRC addressing a major challenge in the provision of public goods and services
- the Australian Photonics CRC was an example of a CRC addressing creation of a new industry area
- the Desert Knowledge CRC is an example of addressing major challenges in creation of a new industry area & a major challenge in the provision of public goods and services
- the CRC for Australian Mineral Exploration Technologies (1992 – 2000) was an example of a CRC tackling a major challenge (the Glass Earth problem) in an existing industry sector where the risk involved in solving the challenge was too great for a single firm to tackle alone.

This list is illustrative not exhaustive.

### 10.3 Fewer rules; more onus on applicant to make the case

The need for a more flexible Program was one of the issues raised most commonly in submissions and consultations about the CRC Program by end-users and research providers alike. Indeed, it was consistently raised as one of the 'dark matters' of the current innovation system during the consultations. It was also noted by the Productivity Commission which said *the Commission considers that there is considerable scope to improve the effectiveness of the CRC model by introducing more flexibility into the types of arrangements that are supported by the program.*<sup>107</sup>

As noted above, many players in the Australian NIS have become very sophisticated at collaboration in the last 20 years or so. They comment that most collaborations and industry/end-user sectors are different. Arrangements that work well for collaboration in one case might not work well in another. Some industry sectors have sophisticated structures for managing collaboration – the mining industry has AMIRA International.

More flexible arrangements can lead to successful large end-user research collaboration as demonstrated by the large Linkage Grants in recent years. They are also more likely to encourage greater participation by SMEs.

#### 10.3.1 Governance and management

A consistent and frequently mentioned theme throughout the submissions and the consultations was that of the complexity and cost of CRC governance arrangements.

*The CRC programme is an attempt to build major national focus in specific industry sectors, but is plagued by major governance and intellectual property challenges, and onerous reporting regime which results in significant administrative overheads. Industry leadership – the mantra for recent CRC rounds – often leads to short term research targets with little longer-term strategic research focussed on industry needs.*<sup>108</sup>

*[T]he administrative processes for initial set up and achieving wind up have created whole service industries.*<sup>109</sup>

<sup>107</sup> Productivity Commission Research Report, *Public Support for Science and Innovation*, p.457

<sup>108</sup> 569-Australian Nanotech Alliance, p.3

<sup>109</sup> 345-Australian Dairy Industry, p.14



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While many submissions focused on problems of governance, there was surprisingly little about management.

The Group of Eight noted that one feature of successful CRCs is that ‘there is a good chief executive officer who can provide both leadership and management of the complex organisation.’<sup>110</sup> This Review emphasises that management issues must be identified and addressed at the application stage. One of the essential elements of any collaboration – no matter what the purpose of the collaboration is or who the collaborators are – is that there be clear identification of the objectives of the collaboration and, most importantly, an allocation of the responsibilities for the tasks required to achieve the objectives.

Of course, managers need to be accountable. Primarily they need to be accountable to the partners in the CRC. This is not necessarily best done through an incorporated entity. As the Australian Mineral Science Research Institute (AMSRI) and many earlier unincorporated CRCs demonstrate, research collaborations do not need to be incorporated to be successful.

Fundamentally, CRCs are joint ventures. Establishing them as separately incorporated entities runs the risk that the entity takes on a life of its own with potential for some of the original objectives to be easily lost sight of. This is all the more so given that directors of an incorporated board owe a duty at law primarily to the company, rather than to any individual or group of partners.

Incorporation certainly creates a legal entity that can enter contracts in its own right, including employment contracts and agreements with the Commonwealth, and this aspect of CRC administration has been simplified: but with greater complexities at other levels. In implementing all the strictures of contemporary good governance, incorporated bodies can become costly to run and potentially removed from the goal.

Unincorporated entities can have more flexibility, but all essential features of the partnership do need to be addressed and documented in a legal agreement between the parties ahead of the start of the joint venture. One most particular need is for the allocation of management responsibilities. If there are multiple partners, they need to come together periodically to make management decisions, much as they would if a large research project were happening entirely within their own corporate structures.

This burden can be eased by appointing one or more partners as agent through whom contractual and systems (IT, human resources, finance, general policy) matters can be channelled. For example, with AMSRI (see AMSRI details in 10.3.8 below), the Commonwealth funding is managed by the University of South Australia. The financial risks are mitigated because the auditing arrangements go through the South Australian Auditor-General. The industry players in this collaboration say they are very happy with the arrangements and with the progress of AMSRI, now in its third year.

In some ways, there can be more accountability in an unincorporated venture, because the partners/owners have to take a more hands-on role to the management. While a board-like group is still required, it should have partner representatives who are authorised to make decisions.

Of course, there may be sound reasons for having a separately incorporated entity, and it should be open to the CRC applicant to make the case. However the decision as to whether it is limited by shares or limited by guarantee is not necessarily as straightforward as the documentation recommended by the Australian Institute of Commercialisation for the 2006 round suggests<sup>111</sup>. Companies which are limited by guarantee cannot distribute the company’s property amongst its members, making problematic the ultimate sharing of the CRC’s research and IP.

Nevertheless, there remains a risk that the Board of a separately incorporated structure can lose sight of the original intention of the joint venture. This should be helped by requiring the CRC to have a very specific purpose: the more specific the shared objective the more likely the participants will stay on track.

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<sup>110</sup> 372(R)-Group of Eight, p.83

<sup>111</sup> CRC Inc 2006 project, Australian Institute for Commercialisation, <http://www.ausicom.com>

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The University of Queensland noted the tension inherent in research providers making *long-term commitments to work with and provide cash and in-kind resources to entities that are independent and whose strategic objectives may diverge over time from those of their primary research providers*<sup>112</sup>.

The increasing emphasis on having Independent Directors is also problematic. Their purpose is to protect the interests of shareholders (of which there are none in a company limited by guarantee), and to ensure that management decisions can be challenged. Where an entity has defined shareholders/members who are aligned and clear on their expectations of the company's outcomes, the need for independent Directors is not so strong.

### **10.3.2 All parties to the joint venture need to be comfortable with governance arrangements**

For the past five rounds, there has been a requirement that research providers not hold a majority of Board positions. This has led to disenfranchisement of the research providers, who in some cases are the main providers of resources into a CRC.

The Group of Eight pointed out that, in some cases *this has reduced the capacity of research providers to influence the direction of research and undermined the cooperative character of the scheme*<sup>113</sup>

There have also been cases of offers to buy Board memberships: *During the development of the case for new CRCs, UWA has received requests for the funding support necessary to 'buy' voting rights on Boards. For instance, here is a quote from one such letter.....'proposed minimum for voting rights for the ZCRC Board of Directors will be in the region of \$200,000 - \$300,000 per annum'*<sup>114</sup>

The CRC Committee argues that the membership requirement is necessary to ensure the Program continues to focus on the longer term needs of end-users and can deliver adoption outcomes and that the Program cannot be 'all things to all people'.<sup>115</sup>

However, the Review believes the arrangement is artificial and should be scrapped. It operates against the notion of a true joint venture.

As the Howard Partners review noted: *Successful collaborations are based on a partnership of equals, not on the dependence or control of one or more of the participants*<sup>116</sup>.

The Review does acknowledge that Board positions should be linked to the input of resources into the CRC, though not necessarily proportionately and not necessarily based on whether the partners are researchers or end-users.

### **10.3.3 More flexible lifespan**

Many submissions argued that a shorter funding period than seven years should be encouraged; some (most notably the CRC Committee) argued for a longer period. While the Program itself did not mandate seven years, most bids seemed to pitch to this length and, indeed, it seemed to be widely understood that this term was required. The majority of end-user submissions commenting on this issue argued for flexibility.

*Pfizer Australia has been approached to participate in a number of CRCs. Although several other multinational companies have participated in this scheme, we have decided not to commit to the full seven-year period. The seven year matched-funding period, plus the nearly two-year development and assessment period is simply too inflexible for our business needs. (And, it is worth stressing, it is longer than the data exclusivity period and the marketing life of most of our patented products in Australia.)*

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<sup>112</sup> 419-University of Queensland, p.3

<sup>113</sup> 372-Group of Eight, p.92

<sup>114</sup> 313-University of WA, p.22

<sup>115</sup> 212-CRC Committee, p.30

<sup>116</sup> Howard review, p.19

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*Our Animal Health Division has joined one CRC after it was established—but to support a 2-3 year program.*<sup>117</sup>

The CRC Committee pointed out that

*SMEs are focussed on shorter term delivery of outcomes and will generally not have business plans extending beyond a few years. This is also true for a number of state and federal government departments where it is difficult to commit to funding beyond the forward estimates period.*<sup>118</sup>

The Review recommends that the general period be 4-7 years, with occasional opportunities for both shorter and longer terms if the situation warrants. Sound arguments would have to be made in each application for the proposed lifespan. Shorter collaborative periods are likely to attract more end-user partners, both large firms and SMEs. In fact, to encourage efficiency and focus in addressing the problem, CRCs should be given every incentive to finish earlier than their originally proposed lifespan.

As noted above, CRCs from now on should be single-round CRCs; but partners who have been part of a previous CRC should not be disbarred from applying for and participating in a new one under the modified Program. Indeed their experience would often be a worthwhile asset in a new CRC.

### **10.3.4 More flexible membership arrangements**

Submissions also argued for more flexibility in membership arrangements with the ability for certain partners to join late and exit early (currently allowed but considered difficult to achieve in practice). GM-Holden commented that:

*The partners are established at the beginning of the CRC and the agreement includes specific levels of contribution from all partners for the life of the CRC. In reality, it is impossible for the industry partners to determine all research areas to the level of detail required over the seven year timeframe of the CRC, and it is possible that some partners may not have the expertise to undertake projects in areas not defined at the start of the program. To address these concerns, a flexible arrangement is required which allows new partners to be brought into specific projects as necessary.*<sup>119</sup>

Macquarie University also called for

*more flexible governance arrangements tailored to the specific objectives of each CRC, including mechanisms to admit new partners after the Centre is established.*<sup>120</sup>

The safeguard against a new partner coming in late and gaining the benefits is that admission will be up to the existing partners. There would have to be sufficient flexibility in the Commonwealth's arrangements with the partners to permit changes to the partners, and for additional inputs to be received over and above the original commitments.

### **10.3.5 Intellectual property arrangements**

Intellectual property arrangements drew a lot of comment. Despite detailed coverage of this matter in CRC legal agreements, early clarity ('an agreement to agree') seems to be what was most lacking.

As noted above (9.2) commercialising research IP has been seen as a potential significant income earner for research providers; however, this potential has rarely been delivered. The Review accepts that continuing unrealistic expectations by universities and government research bodies that the IP within a CRC will generate a major financial flow to their institutions underlies many of the cited difficulties in reaching agreement on IP arrangements. This is exacerbated by the belief – encouraged by the application process – of many CRCs that the CRC itself will be the commercialiser of the IP resident in the CRC. Agreements would be easier to negotiate if it were accepted that the industrial/end-user partners were the logical developers of the IP, with the question of fair and reasonable returns from the industrial partner to the research

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<sup>117</sup> 579(R)-Pfizer, p.12

<sup>118</sup> 212-CRC Committee, p.31

<sup>119</sup> 509-GMHolden, p.32

<sup>120</sup> 440-Macquarie University, p.5

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providers and their institutions the matter to be negotiated, in general terms, at the commencement of the CRC.

As the Australian Dairy Industry has stated:

*Our experience is that much of the research outputs are difficult to translate into benefits, especially where there is a varied opinion about the commercial utility of a technology. Inventors in research institutions often have greater expectation for their innovation and CRC management feels compelled to protect the innovation with a patent. Introduction of a realistic commercial assessment of the outputs seems to be systematically lacking from a number of CRCs in which we have partnered. The solution is to focus on benefits and insist that research is fully utilised by commercial and/or industry partners.<sup>121</sup>*

There were also concerns about unnecessary or complicated arrangements for IP sharing which actually inhibited the practical use of the research outcomes, and had a negative effect on researchers themselves, who are naturally driven to share their research with the wider scientific and academic community. IP arrangements do need to be structured from the very start of the CRC to allow all joint venturers to make use of research findings as quickly as possible, consistent with end-user rapid uptake.

And there are other benefits to simplified IP arrangements:

*A more pragmatic approach to IP management would also reduce the administration cost, especially where most of the activities are directed at public good outcomes.<sup>122</sup>*

The Review notes that the CRC Program does not mandate any particular IP arrangements, only that there be an agreement in advance. If there is a clear expectation that the end-users will commercialise/adopt the results, this may help in clarifying the up-front understandings about the IP.

### **10.3.6 More flexible arrangements but tougher to make a case**

Allowing more flexible arrangements means that the initial case has to be well made. Applicants must demonstrate how the proposed research and education program will address the identified risk and then how the end-user partners will deploy the research findings and gain advantage from the Commonwealth investment with spillovers. There must be no reduction in responsibility and accountability. The expectation is the end-users will adopt or commercialise the results, where commercialisation makes sense, rather than CRCs. Of course, end-users need to have or develop the absorptive capacity to take up the research results – one way might be by employing the PhD graduates.

It is important to note that the Review is not recommending that applications for CRCs should be longer than at present, nor does it recommend that economic-impact studies should be seen as a necessary part of the application. Rather it suggests that the application case should be able to withstand significant scrutiny and challenge.

**Recommendation 3.1:** That the CRC Program guidelines be modified:

- i. to permit much greater flexibility than at present including in organisational structures, governance models, lifespan (typically 4-7 years but up to a maximum of 10 years where appropriate), membership arrangements, intellectual property arrangements and size of Commonwealth grant (up to a maximum of \$45M over the life of the Centre) but
- ii. that there be even higher requirements than at present on applicants to demonstrate why their proposed structure, membership arrangements, research plan, end-user absorptive capacity, leadership, key research people, outputs, likely impacts, performance metrics, governance, management, intellectual property arrangements, Centre lifespan and funding are appropriate to deliver a solution to the identified challenge and the fast and effective uptake of results by end-users.

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<sup>121</sup> 345-Australian Dairy Industry, p.14

<sup>122</sup> *ibid.*

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### 10.3.7 The legal agreement between the Commonwealth and the CRC

*The law should be an enabler to the innovation environment, not an inhibitor.*<sup>123</sup>

The Review has noted and agrees with the comment of Fitzgerald and Austin, law academics who work with the Open Access to Knowledge (OAK) Law Project at Queensland University of Technology:

*Our survey and study of Australian and overseas projects show that collaborative innovation and the transfer of ideas are often impeded and curtailed by problems and delays arising out of the negotiation and formalisation of agreements for collaborative research. Finalising agreements for collaboration can take longer than the actual project and frustrated parties may take steps to avoid the formalisation of collaborative research agreements.*<sup>124</sup>

This does not undermine the need for agreements: between the partners themselves, and between the partners and the Commonwealth. In the case of the Commonwealth, it is reasonable that it should want to deal with only one entity in establishing the contractual relationship that underpins the funding of a successful CRC. Where the CRC is not incorporated, appointing an agent is a way to address this issue. However, it should strive for simplicity in spelling out the obligations on each side.

Monash University:

*There should be a simplification of the administrative and legal frameworks within which CRCs are established in order to reduce the need for complex, time-consuming and costly legal advice and to foster direct collaboration between participants rather than through intermediary research management companies*<sup>125</sup>

**Recommendation 3.2:** That the legal agreement between the Commonwealth and the CRC be as simple as possible, with the recent practice continued of one party (the CRC itself or an agreed agent) signing on behalf of the CRC.

#### 10.3.7.1 Ethics compliance

The Review has noted and supports the Commonwealth's past practice in requiring CRCs to comply with relevant ethics codes and guidelines. It has also noted the introduction of the new *Australian Code for the Responsible Conduct of Research*, developed by the NHMRC in partnership with the Australian Research Council and Universities Australia, which promotes integrity in research by providing guidance on

*for example, how to manage research data and materials, how to publish and disseminate research findings, including proper attribution of authorship, how to conduct effective peer review and how to manage conflicts of interest.*<sup>126</sup>

The Review encourages the Commonwealth to update the legal agreement to include a requirement for compliance with this Code as well as the relevant ethics codes; and to draw this requirement to the attention of CRC applicants in the Application Guidelines.

**Recommendation 3.3:** That the legal agreement include provisions requiring the CRC to be fully compliant with all relevant Commonwealth and State research integrity and ethics codes and guidelines and with all international treaties dealing with these matters. Records of all ethics applications and their current status must be kept up to date and be available at all times for inspection.

### 10.3.8 Models

Possible models for what CRCs might look like include the following:

**AMSRI (Australian Mineral Science Research Institute):** A large ARC Linkage grant that has many features in common with current CRCs but some important differences.

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<sup>123</sup> 428A-Fitzgerald & Austin, p.3

<sup>124</sup> 428A-Fitzgerald & Austin, p.13

<sup>125</sup> 406-Monash University, p.18

<sup>126</sup> <http://www.nhmrc.gov.au>



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AMSRI comprises ‘four existing world-class mineral research centres’<sup>127</sup>, namely three ARC Special Research Centres at the Universities of South Australia, Melbourne and Newcastle and the Julius Kruttschnitt Mineral Research Centre at the University of Queensland, together with a global network of associates and collaborators. AMSRI’s purpose is to ‘undertake transformational research, designed to underpin Australia’s minerals industry in the decades ahead’<sup>128</sup>. The ARC is providing \$8.6 million to the five-year program, the universities \$4 million, and industrial partners – including BHP Billiton, Rio Tinto, Anglo Platinum, Phelps Dodge, Orica Mining and Xstrata Technology – \$7.5 million. The South Australian Government has also provided \$2.5 million and the Victorian Government \$1 million. The headquarters of AMSRI are at the University of South Australia.

AMSRI partners report that it has worked well because:

- there is a clear sense of purpose and all parties are clear on it
- IP arrangements were sorted out in advance with an emphasis on industry doing the uptake and any commercialisation of new discoveries
- scientific publication arrangements are clear
- all partners had prior experience working together in various configurations
- the research groups involved all are high-impact groups with international standing
- the industry partners had great respect for the research groups involved
- the arrangements for PhD students were sorted out in advance and no student can be involved in projects where the IP is destined for early commercialisation
- a light-touch governance model based on the Advisory Board for the Ian Wark Institute at the University of South Australia which has worked well for 10 years.

As noted in 10.3.1 above, AMSRI is unincorporated.

**Intermediary:** Another possible model is that of the intermediary, the aim of which is to build up, shape and encourage top-class research and education/training to address the core challenge identified by the emerging or transforming industry/public-end-user group applying.

These CRCs would be effectively technology-pull and would have the following characteristics:

- industry/end-user players would have to have their act together e.g. industry-wide plans
- industry/end-user players would be expected to contribute at least 50% of the cash to the CRC (but they might get a tax concession). Funding should come from the industry/end-user players and from the CRC grant. (Contributions from PFRA or universities would not be mandatory but rather there would be more of a contract research relationship).
- PFRA and universities would pledge to provide expertise and PhD supervision (universities only) through the life of the CRC.

In a case like this, the intermediary might well be an incorporated body. The CRC would use its money to (fully) fund pre-competitive research, education/training up to PhD (producing a supply of graduates), research capacity development, research deployment capacity, research cluster development, and linking to expertise overseas. By the end of the CRC there should be a lively network of concentrated research capacity to continue to support the industry and produce graduates, and there would be a healthy intermediary (the by-then-former CRC). As the commissioning organisation, the CRC would be the owner of the IP although it might provide some incentive in this area to the researchers.

#### **10.4 Encouraging collaboration for SMEs and services industries: an auxiliary program**

Public-sector partners are experienced at submitting big grant applications, but industry (especially those sectors populated by SMEs and those where few large Australian companies are prominent in global value chains) and other end-users often find it much harder. And they find it hard to locate the most appropriate research partners. For many firms in the

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<sup>127</sup> [http://www.jkmrc.uq.edu.au/research/mineral\\_processing/australian\\_mineral\\_science\\_research\\_institute.htm](http://www.jkmrc.uq.edu.au/research/mineral_processing/australian_mineral_science_research_institute.htm)

<sup>128</sup> See <http://www.unisa.edu.au/iwri/aboutthewark/australianmineralscienceresearchinstitute.asp>

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manufacturing, services and related industries, collaboration is not part of the established business model.<sup>129</sup>

*The process of assessing new collaboration opportunities and partnerships can be time consuming and financially risky for a small business.*<sup>130</sup>

Yet to optimise opportunities arising from the convergence of technologies, markets and capabilities, collaboration can be the key to long term success.

The development of new collaboration networks in industries where collaborations are not common could be facilitated by the introduction of a new program, perhaps as an auxiliary to the CRC Program. Its purpose would be to assist groups to explore shared problems, formulate shared approaches to solving them and establish the details of more formal collaborations.

Under such a program, groups would:

- have an opportunity to explore, frame and experiment with ideas, challenges, problems and opportunities affecting their sectors
- get the definition of their problems right and work how to go about solving them
- identify appropriate research partners and end-users
- work out the formal arrangements for working together including IP, management and governance arrangements
- find out who is doing similar work around the world and decide whether to seek them out as international partners, or direct their own focus into other areas
- work out the skilled labour force requirements.

A possible outcome of such projects could be the formation of consortia to apply for CRC funding or funding through other Commonwealth and State initiatives. For SME and service industry groups the new program could enhance their participation in the CRC Program or other collaborative R&D activities.

The Chairman of the Australian Seafood CRC has provided some useful tips on establishing collaborations and bidding for a CRC in a presentation he gave to the CRCA08 conference<sup>131</sup>. He emphasised the need to 'start as you intend to operate', from concept development through to submission and interview.

The new program could build on the principles established under the Industry Cooperative Innovation Program. It would be to the CRC Program what the ARC Networks Program is to the ARC Centres of Excellence. The ARC Networks Program proved to have unexpected benefits, especially in the Social Sciences.

The new program could also complement and be a useful avenue of support for the proposed Industry Innovation Councils, which are to be introduced by the Commonwealth Government later in 2008. These Councils are intended to draw members from 'leaders in innovation, business, unions and professional organisations, science and research agencies and government' and act as 'key advisory bodies to Government and as innovation advocates'<sup>132</sup>. They will operate in 'key sectors' to support the Enterprise Connect network.<sup>133</sup>

**Recommendation 4:** That a new program be established to assist industry and other end-user groups to undertake strategic analysis or innovation mapping projects and to establish collaborative ventures between end-users and researchers, including publicly funded research institutions. The priority is to support new collaborations in areas with little history of collaborative activity or a low research and development base, particularly service industries and those sectors populated by SMEs.

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<sup>129</sup> See section 2.3 of this report for some statistics on Australian business collaboration

<sup>130</sup> 113-Australian Institute for Commercialisation (2), p.5

<sup>131</sup> Peter Dundas-Smith, address to CRCA08 conference, available at <http://www.crca.asn.au>

<sup>132</sup> Minister for Innovation, Industry, Science and Research Press Release, 8 May 2008,

<http://minister.innovation.gov.au/SenatortheHonKimCarr>

<sup>133</sup> <http://www.ato.gov.au/budget/2008-09/content/bp2/html/expense-20.htm>



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## 10.5 Participants

### 10.5.1 SMEs, services and the Humanities and Social Sciences

**SMEs:** A wider diversity of participants needs to be encouraged to optimise the opportunities for innovative collaborations. In particular, SMEs have long been identified as a vital part of the Australian economy. However they are vulnerable; growing and developing them is a challenge. Many have little time or capacity for accessing transformative research. Their involvement in CRCs needs to be specifically encouraged. This can in part be done through providing examples in the Application Guidelines of best-practice SME involvement and information on cognate programs such as R&D Tax Concessions and the ARC Linkage grants.

**Services industries:** Likewise, Australia's domestic economy is a services economy. So far service industries have not made significant use of the CRC Program and they too need to be encouraged to collaborate with others to develop innovative solutions to pressing problems and challenges.

**Humanities and Social Sciences:** At the moment the CRC Program only funds applications that are from predominantly science and engineering fields. However as the boundaries between sciences and the social sciences are increasingly blurred in multidisciplinary areas and as most pressing real-world problems require collaborative, multidisciplinary solutions, for which humanities and social sciences input is vital, this distinction is rapidly becoming out of date.

Extending eligibility to researchers in the fields of humanities and social sciences would enable the services sector to participate in the CRC Program more fully. Given that a substantial proportion of innovation comes from process innovation, it would be foolish to exclude opportunities for collaboration and research in these fields. These are also fields that can contribute to resolving major public good problems, particularly in areas of social justice and social services.

### 10.5.2 Universities and education

Because education – especially research training – is essential to developing Australia's innovation capacity, and because universities are significant research providers, it is important that every CRC applicant secure a commitment in the bid from at least one Australian university. The university must guarantee to provide supervision for PhD students associated with the Centre, in return for CRC funding of the supervision.

In Australia only universities can award doctorates. Australian universities all have codes of conduct for PhD supervision. To provide the right framework for postgraduates associated with a CRC, the CRC will have to have a close working relationship with a university. Many universities are happy to appoint adjunct staff and train them in PhD supervision. Thus CRC researchers not employed by a university can be at least co-supervisors of PhD students if the university agrees.

Many submissions praised the way CRCs had helped produce 'industry-ready' PhD graduates and, to a more limited degree, first-degree graduates: for example.

*GM Holden has derived benefit from participating in Auto CRC's undergraduate research program. GM Holden was involved in 15 projects in the first year and this enabled GM Holden to develop relationships with 30 talented students and to showcase potential career opportunities in a highly competitive job market.<sup>134</sup>*

But the Go8 said in its submission:

*While many Go8 undergraduate and postgraduate students spend time in CRCs, the available evidence is inconclusive about the relative quality of the training that takes place. The only study that we are aware of (Manathunga 2005<sup>135</sup>) found that compared to PhD students based solely in a university or other type of research centre (medical research institute for example) those located at CRCs indicated much lower levels of satisfaction with their overall educational experience. For example, 63% of CRC*

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<sup>134</sup> 509-GMHolden, p.22

<sup>135</sup> Manathunga C., Pitt R. & Critchley C., *Australia's future research leaders: Are they coming from CRCs?* Final report on the pilot project, The University of Queensland, as quoted in Group of Eight submission.

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*graduates indicated satisfaction with their PhD experience, compared to 83% for graduates of university schools and 75% for graduates of other centres. Further, only 58% of CRC graduates agreed that the skills they developed during their candidature prepared them for post-graduation employment compared to 75% of university school graduates and 62.5% of graduates from other research centres. Further research of this type is required.*<sup>136</sup>

The authors of the report just quoted by the Go8 also made a submission to the NIS Review, reporting on the findings of their pilot project, and indicating that they are undertaking an ARC Linkage-funded larger study. In light of the pilot study findings and in view of the comments of the Go8 universities which produce large numbers of PhDs through CRCs, the Review agrees this issue needs further study. The Review draws attention to the recommendations of the Manathunga report for improving research training within CRCs:

- *Enhanced industry involvement during candidature beyond providing students with fieldwork or data collection opportunities*
- *Additional programs to develop students' ethical and social understanding*
- *Additional industry and business mentoring and exchange programs for students*
- *Increased support for students to present their research to a variety of audiences*
- *Greater provision of opportunities for students to be active in student, industrial, and professional organizations*
- *Additional seminar programs and coursework.*<sup>137</sup>

### **10.5.3 International engagement**

Currently, there is little encouragement in the CRC guidelines for international engagement. The guidelines prohibit the use of grant funds for research undertaken overseas, although the contributions from participants may be used.

As discussed in 2.4, involvement on the international stage is vital if Australia's innovation system is to develop to its full capacity. Some of our big problems are shared around the world, and we must promote opportunities to bring multi-country perspectives and knowledge to bear on their solution. The potential deployment of the research solutions may be better realised through international take-up or commercialisation; and involvement of international researchers and users can help open new markets.

International collaboration will ensure that Australia stays at the forefront of knowledge about grand discoveries and creative approaches to perennial research questions, and is well positioned to deploy the solutions for its own benefit. It gives us recognition in the international research community, which in turn leads to more opportunities for developing our knowledge and building our capacity to innovate for technological and social advancement.

These international links can occur through having international research agencies as participants in a CRC, or through international end-users, or both. There should also be opportunities for special (often PhD) training overseas.

Strong engagement with international research groups working on similar challenges to those of an Australian CRC must be encouraged including, where appropriate, joint projects. It is not unreasonable to extend CRC funding to research undertaken overseas, provided it meets the Program objectives, including that the research outcomes be of significant national benefit, and there are safeguards on the accessibility of CRC outputs to Australian end-users.

The ARC has commented that

*participation in schemes to fund international collaboration, for example, International Centres of Excellence or international exchange programs is critical to enhancing Australia's ability to reap the benefits of improved access to new ideas and to high quality research environments and facilities outside Australia.*<sup>138</sup>

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<sup>136</sup> 372-Group of Eight, p.82

<sup>137</sup> 557-Manathunga Critchley, p.2

<sup>138</sup> 576-Australian Research Council, p.9

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**Recommendation 5:** That participation in the CRC Program be encouraged, allowed or required as follows:

- i. SME and service industry involvement in CRCs be specifically encouraged;
- ii. CRCs addressing challenges across several service industries be encouraged;
- iii. strong engagement with international research groups working on similar challenges be encouraged including, where appropriate, joint projects; and that funding of research undertaken overseas be allowed;
- iv. CRC applications in Humanities and Social Sciences fields be allowed and encouraged; and
- v. CRCs continue to be required to have at least one Australian university as a partner.

## 10.6 Funding arrangements in a CRC

### 10.6.1 Different levels of funding for different types of CRCs

The Productivity Commission's finding 10.14 that the CRC Program could be improved by aligning

*the share of public funding ... to the level of induced social benefits provided by each CRC, thereby reducing some of the large rates of subsidy to business collaborators<sup>139</sup>*

is directed at reducing some of the large rates of subsidy to business collaborators. There are sound reasons, enunciated earlier in this paper, as to why Government should support researcher/end-user collaborations in areas of market failure and market creation. The areas of greatest market failure are in the area of social justice and community and it is arguable that these areas should have a greater proportion of Government funds available to support collaboration. However, social benefits are not solely limited to public sector activity, so the real standard for allocating Government funding should be the likely level of social benefit which will be achieved if the particular research problem proposed as the foundation of the CRC is solved.

### 10.6.2 Expected contributions

Contributions to CRCs can be made in different ways, but in the past the balance between the Commonwealth, research-providers and end-users has not been the most effective.

**Matching funding:** The Productivity Commission stated:

*Notably, the user-contribution to CRCs in Australia is also of the lower end of international experience with funding arrangements for public-private partnership programs. For example, in many countries including the United States, Norway, Sweden, Finland and France, industry users are required to contribute at least 50 per cent of total program funding<sup>140</sup>.*

Requiring end-users to provide substantially higher matching funding to the Commonwealth's contribution than is required at present would be in line with international best practice for major centres.

**In kind and cash:** These have been treated as effectively equivalent in the CRC Program; and tied cash is largely equated to untied cash. This provides a distorted view of what resources are actually available to a CRC's management.

As noted earlier in this report, there has also been a problem of properly accounting for the in-kind contributions, which has been replaced by a standardised approach that does not necessarily reflect full costs. A different approach is needed.

However, CRCs remain an excellent way for SMEs to have access to high-quality research to solve major problems in their industries: but they are typically less cashed-up to support the quality of research required. Consequently an acknowledgement of their commitment through in-kind contributions is warranted.

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<sup>139</sup> Productivity Commission Research Report, *Public Support for Science and Innovation*, p.455

<sup>140</sup> *ibid.*, p.444

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**University contributions:** The gap between research expenditure and research income in universities has been identified above as a major driver of seemingly perverse behaviours by university research providers in collaborations with end-user groups. Arguments for addressing this are supported by this Review. In parallel, this Review suggests that whether research providers make cash or in-kind commitments to CRCs should be a matter of choice.

As the University of Queensland has stated:

*The provision of cash by universities, even when it is linked to perhaps a three-to-one return, is not sustainable. The reason is that the funds received by a university from a CRC are targeted (not unreasonably) to particular research projects and outcomes. But, the funds that a university provides to CRCs come from the scarce pool of discretionary funds. And those funds, especially without acknowledgement of the true costs of research, are shrinking.*<sup>141</sup>

**Public sector end-users:** While public good CRCs have been among the most successful, there has been an ongoing concern that applications in areas of Commonwealth and State Departments are not always in line with the governments' plans and objectives in those portfolio areas. It is important that applications provide evidence that relevant Government agencies and portfolios, whether State or Commonwealth, strongly support the CRC application.

The Chief Scientist says

*Government authorities need to invest in the same way companies invest. If government authority is serious about what it wants, it really needs to put in appropriate investment. Government authorities should not expect to get all the results for nothing even though government may be putting some core funding into the CRC.*<sup>142</sup>

**Postgraduate stipends:** At present CRC Program funds cannot be used to offer stipends to postgraduate students above ARC/NHMRC rates, although the stipend can be, and often is, augmented by participant contributions. The Review sees no need for this arbitrary limit on the use of Program funds to be imposed, if stipends can be used to attract keen research students to contribute to the CRC's problem-solving capability.

**Recommendation 6:** That the approach to funding of CRCs be redesigned in accord with the following:

- i. the share of public funding of any CRC be aligned to the level of likely induced social benefits;
- ii. CRC end-user applicants normally be expected to provide more than half the cash contribution towards the CRC;
- iii. in-kind contributions not be rated the same as cash during the selection and reporting processes, but treated as an important secondary factor. In turn, tied in-kind contributions (which should be declared at the time of application and in annual reporting) should not rate as highly as untied in-kind contributions;
- iv. there be scope to modify the application of recommendations ii and iii to the advantage of end-user applicants where they are predominantly SMEs or from the community sector;
- v. universities and PFRAs be encouraged but not explicitly required to make cash or in-kind commitments to a CRC bid – but that, where they do make contributions, they be described in the same way as for other university/end-user collaborations (e.g. ARC Linkage Grants) and that they include details of program leaders and key researchers and their time commitments;
- vi. predominantly public good applications be scrutinised to see that they do indeed have the funding support of the 'home' Commonwealth and State portfolios or authorities; or, where this is not the case, that the reasons why are addressed as part of the application; and;
- vii. there be no upper limit on postgraduate stipends offered within CRCs.

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<sup>141</sup> 419-University of Queensland, p.3

<sup>142</sup> From *Chief Scientist's response to the Minister's question on the Cooperative Research Centres (CRC)*, 11 February 2008, provided to the Review

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## 10.7 Selection, Metrics & Reviewing

The Review recommendations are aimed at ensuring a greater diversity of CRCs with organisational arrangements designed to maximise the chances for each particular CRC to be as effective as possible. Encouraging this diversity and instituting the increased flexibility the Program needs will require program managers experienced in end-use-focussed research, research management, and program design and management. The Review recommends such expertise be co-opted into the Program from across the NIS.

### 10.7.1 Program administration, the CRC Committee and Selection Process

Peer review is the best system devised to date for selection of large grants such as those in the CRC Program. To implement rigorous peer review, changes to the CRC Program decision-making/administration process are desirable.

First, as noted briefly above, to support the peer review and CRC Committee process, senior administrative expertise is required. Seconding expert research managers into grant administration for a limited period (typically three years) is a very successful model used at the ARC and NHMRC in Australia, and by the National Science Foundation and the National Institutes of Health in the USA. Such a model would go a long way to improve the communication with the currently disgruntled research provider sector.

Secondly, the CRC Committee itself must have the necessary breadth of experience and expertise. Members with experience as senior R&D managers or with experience in leading, high-quality, end-user-oriented research teams are essential.

Fitzgerald & Austin argue for:

*the provision of government appointed ‘innovation officers’ who will manage and finalise research agreements for collaborative projects. These officers will be trained to facilitate the completion of collaborative research contracts, to balance and resolve issues between parties, to engage with the private sector and to implement collaborative research ideas into innovative outcomes. They will operate from a position focussed on achieving innovative development and unhindered by party bias.<sup>143</sup>*

Thirdly, and most importantly, peer review assessors must be used in the selection process. Selecting appropriate peers needs careful attention. The CRC Program should draw on the expertise and experience in complex peer review in other parts of the NIS, most particularly on the ARC and NHMRC which both maintain well-constructed databases of possible names for peer review of research, university/industry collaboration and education programs.

#### **Recommendation 7.1:** That

- i. the CRC Program be administered at senior levels by secondees from across the NIS who have experience with similar programs as successful research end-users, researchers and research administrators.
- ii. CRC Committee members be chosen to ensure the committee has expertise in program design, delivery and review, and significant experience in successful joint ventures deploying research results.

### 10.7.2 Selection Criteria

Rigorous assessment against criteria aligned to the Program objectives is essential. Under the modified CRC Program proposed, changes to the current selection criteria are required and selection should be fundamentally based, in line with best practice for grants as large as this, on peer review.

The Review has noted that the CRC Committee reviewed the 2006 guidelines and revised the selection criteria in preparation for the 2008 round, which has been delayed pending this Review. The revised selection criteria were road tested with the Defence Future Capability Technology Centre (DFCTC) Program (which was modelled on the CRC Program) and ‘provided

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<sup>143</sup> 428A-Fitzgerald & Austin, p.13



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a much improved and simplified application process, both for applicants in writing their proposals and for the review committee'.<sup>144</sup>

**Recommendation 7.2:** That the selection process involve layered peer review against detailed selection criteria which include the following:

- the risk being addressed (how significant is the problem? What is the current state-of-the-art worldwide in addressing this problem?)
- the quality of the research approach and plan and how it will address the identified risk
- the capabilities of the participants (how well do the proposed end-users connect with the identified problem, and how highly regarded in their field are the proposed researchers?)
- the quality of the leadership and the research and management teams
- the quality of the education program;
- the proposed success/progress metrics
- how the end-user partners will deploy the research findings and gain advantage from the Commonwealth investment
- the expected wider spillover benefits and how these will be taken up by parties outside the collaboration
- the genuineness of the joint venture and alignment of interests (i.e. checking that it is not 'hollow collaboration'), and
- the suitability of the proposed accountability and governance arrangements including the management of the proposed joint venture.

**Recommendation 7.3:** That:

- i. CRC applications be submitted using a two-stage process. Applicants would initially make the case in a written application(s) and, if shortlisted, following peer review, would be given the chance to augment this at interview;
- ii. the CRC Committee establish disciplinary-based standing committees drawing on expertise in the ARC and NHMRC to manage the peer-review processes associated with the first-stage culling, and second-stage ranking. These committees should use a common formal process which should include giving the applicant CRC the chance to comment on assessors' comments in writing;
- iii. the CRC Committee consult with the ARC and NHMRC to develop a joint database of assessors to do the rigorous assessing of CRC applications for consideration by the standing committees;
- iv. the standing committees rank proposals assigned to them on all criteria after obtaining sufficient peer assessments, and then overall, and make recommendations to the CRC Committee; and
- v. the CRC Committee consider all the input and recommend a final list to the Minister.

### 10.7.3 Metrics

Hard-nosed review using common measures across all CRCs (and across other collaboration programs) should be encouraged. Development of appropriate research quality and research training quality metrics should occur in consultation with the Excellence in Research for Australia (ERA) Initiative managed by the ARC. This is particularly important for ensuring research quality metrics that are appropriate for the range of disciplines (from humanities and the social sciences on the one hand through to science and engineering) and the typically multidisciplinary fields that characterise the CRCs.

**Recommendation 7.4:** That a common core of evaluation metrics be developed that would apply across all CRCs and would allow for cross-comparison between them. These should include, at minimum, metrics on research quality, end-user uptake, international connections for national benefit, and researcher education. As well as reporting on the core evaluation metrics, it is recommended that CRCs, in their annual report, report on measures specific to their CRC and agreed at the time the CRC is awarded.

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<sup>144</sup> 212-CRC Committee, p.38

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#### 10.7.4 Reviewing and possible closure

Successful review mechanisms are one of the keys to running a successful research funding program. They help maintain rigour and focus, and ensure accountability. Review mechanisms are not useful if they have no consequences.

There needs to be a mechanism for quickly closing off Commonwealth funding when the review processes reveal failures against the agreed measures. To date practically no CRCs have been closed as a result of review processes. This is most unusual in Commonwealth funding programs.

A level of failure should be expected and accepted as the CRC Program will cover areas where there are risk gaps. One measure of the success of the Program itself is whether CRCs are being closed: it shows whether the Program is taking enough risk. As Dick Davies says in his submission

*In managing risk and uncertainty public sector support programs must recognise that a proportion of well managed projects will fail to realise their objective. The important thing is that they are well managed, not that they fail. Indeed, if a certain proportion of well managed projects do not fail, then it is likely that the program is risk averse and of little use in stimulating innovative activity. Administrators should formulate an idea of what is acceptable risk. What level of failure can be tolerated?*<sup>145</sup>

As this Program is funding high-risk ventures there should be an expectation by those running and participating in the Program that at least one-quarter would lose funding at each review round. The funds saved would be freed up for later rounds of the Program.

**Recommendation 7.5:** That annual reports be examined closely for early warning signs of difficulty.

**Recommendation 7.6:** That a major hard-nosed review using a common evaluation framework take place at the end of each 3 years – or if there are early warning signs of failure – of the life of a CRC, with a final review as it is finishing; and that it be an explicit condition of funding that termination be an option if the review’s findings are adverse.

**Recommendation 7.7:** That the CRC Committee establish a Review Sub-committee to

- i. oversee the review process;
- ii. propose the composition of the initial and subsequent review panels to the CRC Committee for approval. The same review panel should be used for all CRCs in a field of application in order to ensure cross comparison. Each review panel to be chaired by a Sub-committee member;
- iii. consider feedback from the review panels;
- iv. prepare a report for the CRC Committee on each review round including a list of CRCs reviewed, ranked by success to date; and
- v. propose which CRCs continue to receive Commonwealth funding under the Program and which should no longer be funded.

#### 10.8 Relationship to other programs in the NIS

This recommendation goes to the Productivity Commission’s second finding on CRCs. It differs from the PC recommendation in that it does not recommend the setting up of a separate pilot scheme.

**Recommendation 8.1:** That the CRC Program build close policy and operational links with other collaborative research programs in the National Innovation System and that it articulate well with the CSIRO National Research Flagships Program, ARC Linkage Program and the NHMRC Partnerships for Better Health Program. While the CRC Program should focus more on funding large end-user-driven collaborative pre-competitive research, the Linkage Program should continue to fund simpler end-user/university partnerships. In line with the move to larger Linkage grants, these programs should complement the CRC Program by supporting long term-basic/strategic research with

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<sup>145</sup> 77-Dick Davies, p.3



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**smaller, shorter and more flexible arrangements between groups of firms either** independently or in conjunction with universities and public sector research agencies. The administrators of these programs (and related State programs) should meet regularly to discuss applications that might be eligible to either scheme.

Over time the NIS needs to improve its capacity to assess the effectiveness of government investment in innovation (and in particular collaboration) and understanding/tracking/reviewing our government-funded innovation programs.

*As the number of funding bodies and initiatives grow, each brings with it different application and reporting protocols dependent on different contract management and evaluation. This is on top of inconsistent program objectives. Typically, a single project undertaken by CSIRO in agricultural research can be part of a CRC and be partly funded by an RDC. This can mean reporting at multiple levels to satisfy the individual governance needs of the three stakeholders. Yet, all these fund sources are mostly about investing public money. Streamlining of programs and unifying their administrative and governance requirements would significantly increase productivity from existing investments, and result in more of the funding supporting the direct costs of science. CSIRO believes that the solution to this challenge lies in developing standard sets of governance arrangements and performance measures to reflect agreed principles for public-sector funding of innovation, according to the role of each type of program within the NIS.<sup>146</sup>*

**Recommendation 8.2:** That

- i. a common core of broad evaluation measures be developed that would apply across all Government innovation funding programs (especially programs involving collaboration) and their projects;
- ii. common application and review forms/processes be used as far as possible across all innovation funding schemes, especially schemes involving collaboration (including Federal & State schemes); and
- iii. a much improved capacity to review innovation funding programs (especially schemes involving collaboration) be developed along with a robust capacity to cease funding weaker projects. Sometimes international review mechanisms are needed.

## 10.9 Valuing research concentrations formed in CRCs

The CRC Program has not collected formal research quality measures for CRCs in recent years, but the Review noted that in some cases CRCs had been the catalyst for the formation of high-quality research concentrations in areas of national importance. In many cases the members of these research concentrations are often physically dispersed and thus there is a danger that when CRC funding finishes, the concentration will dissipate. The Review suggests that in many cases these research concentrations would be excellent candidates for the Centres of Excellence Program and recommends that that program be enlarged to open up the possibility of such concentrations migrating to it.

**Recommendation 8.3:** That the ARC Centre of Excellence Program be enlarged and become annual and that it encourage applications from innovative research concentrations that have proved themselves producers of high quality and high impact research through programs such as the CRC Program (but also through multi-partner, collaborative ARC Discovery and Linkage grants).

## 10.10 Other Programs to consider

In reinvigorating the CRC Program the Review suggests that the Commonwealth consider some of the exciting features of some collaborative programs from other countries, such as the ones briefly described below.

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<sup>146</sup> 217-CSIRO, p.15

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### 10.10.1 Irish Competence Centres

In 2007 Ireland launched a call for proposals for new 'Competence Centres', which are to be industry-led collaborative research entities. The network of Competence Centres is designed to foster collaboration between companies with high-level R&D spend and trained researchers. The companies participating in these centres will share the researchers' intellectual property and in return help bring their results to market. The Competence Centres initiative involves all the State industrial research and development agencies, working together under the auspices of Technology Ireland<sup>147</sup>.

Consideration could be given to introducing a program similar to Ireland's Competence Centres Program in Australia as a complement to other industry-facing programs.

### 10.10.2 Defence Advanced Research Projects Agency challenge program

The DARPA challenge program consists of

*project-based assignments organized around a challenge model: DARPA organizes a significant part of its portfolio around specific technology challenges. It foresees new innovation-based capabilities and then works back to the fundamental breakthroughs required to make them possible. Although individual projects typically last three to five years, major technological challenges may be addressed over longer time periods, ensuring patient investment on a series of focused steps and keeping teams together for ongoing collaboration. Continued funding for DARPA projects is based on passing specific milestones, sometimes called "go/no-go's."*<sup>148</sup>

Consideration could be given to introducing a program similar to the DARPA Challenge Program to tackle grand national challenges.

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<sup>147</sup> Maxim Kelly 'Govt launches voucher scheme for R&D', ElectricNews.net, Thursday 22nd March 2007 [http://www.theregister.co.uk/2007/03/22/vouchers\\_for\\_randd/](http://www.theregister.co.uk/2007/03/22/vouchers_for_randd/)

<sup>148</sup> from [http://en.wikipedia.org/wiki/Defense\\_Advanced\\_Research\\_Projects\\_Agency](http://en.wikipedia.org/wiki/Defense_Advanced_Research_Projects_Agency). And see also <http://www.darpa.mil/>



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## 11 Conclusion

This Review has concentrated on exploring why a program that was initially popular and well regarded has declined in appeal to research providers and not attracted firms in sufficient numbers to generate innovation on a whole-of-industry basis. It acknowledges the economic impact of the Program to date, but believes the large investment of public funds in CRCs will produce greater returns if the Program is refreshed and modified. The recommendations go to keeping a tight but flexible focus on the purpose of CRCs, and providing support structures that will work. The auxiliary program is designed to attract more industry players so that important pre-competitive, pre-applicative problems that traverse a whole industry or social need can be solved, using the best research minds in the country. Getting the best researchers means ensuring the Program is again attractive to research providers so that they will be keen to contribute their leading researchers.

The Review expects implementation of the recommendations to result in many more end-user industries and service providers being involved in CRCs. End-users will come from a wider range of industries and services than have so far participated in CRCs. More of them will be SMEs. Universities and PFRAAs will be excited about the opportunities for quality research with potential national and international impact and will be enthusiastic participants. They will partner with end-users as joint venturers in CRCs to tackle big problems that affect a whole industry or sector or community. The solutions will be rapidly deployed by end-users to the benefit of end-users and, through spillovers, the wider community. CRCs will be diverse in structure, size and longevity. Some will be quite small; others large. Some will be short term; others for a longer term of up to 10 years. Some will incorporate; others will choose different management and governance structures that suit their purpose. Most will have international connections so that Australia can be informed by, and inform, the rest of the world. Employers will compete for researchers and PhD graduates from CRCs. There will be growth in related programs, including ARC Linkages, to develop and nurture collaborative activity. When the problem is solved, participants will move on to other forms of collaboration to solve other problems. Success on all these fronts will be a measure of the relevance and importance of the CRC Program to Australia's innovation system. Success will also guarantee a sound return on the Commonwealth's investment. And success will contribute to a sustainable, community-oriented, productive, creative and prosperous Australia.

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## 12 Appendixes:

### 1 Terms of Reference

Recognising the work already undertaken by the Productivity Commission in its report on *Public Support for Science and Innovation*, the Collaboration and CRC Working Group shall, within the context of the overall Review of the National Innovation System, provide input to the Panel by:

1. Considering the current status of collaboration between various actors in the National Innovation System (firms, universities, research agencies (public and private), Government Departments) propose ways to strengthen such collaboration, having regard to:
  - a) both domestic and international collaboration;
  - b) the role of venture capital;
  - c) the role of intermediaries.
2. Considering options to improve industry access to and use of knowledge generated within universities, public sector research agencies, and organisations with substantial amounts of public funding, such as CRCs, including principles to govern the diffusion of publicly funded research.
3. Evaluating the scope for public and private research partnerships to support comparative advantage in particular industries.
4. Noting that the next CRC selection round has been suspended until the Government has considered the outcomes of the Review, assess the appropriateness, effectiveness and efficiency of the CRC Program within the spectrum of program options to support greater collaboration.

In addressing this, the Working Group will take account of the Government's stated intention of restoring public benefit as a key criterion for the establishment and operation of CRCs. In this context, the Working Group will assist the Review Panel by undertaking a comprehensive review that considers all aspects of the CRC Program. It will examine the overall strategic direction of CRCs, looking at the full range of issues, including governance and program design issues, the level and length of funding needed to support the Program's objectives, as well as its overall scope and effectiveness.

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## Appendix

### 2 CWG membership

Emeritus Professor Mary O’Kane (Chair), Executive Chairman, Mary O’Kane & Associates Pty Ltd

Professor Warwick Anderson AM, Chief Executive Officer, NHMRC

Dr Megan Clark, Vice-President, Health Safety Environment Community & Sustainability, BHP-Billiton

Mr Marty Gauvin, Managing Director, Hostworks Group Limited

Emeritus Professor Tom Healy AO, Professorial Fellow, Particulate Fluids Processing Centre, an ARC Special Research Centre, University of Melbourne

#### Members’ involvement with CRC Program

##### Professor O’Kane

Member, Cooperative Research Centres Committee 1997-98

Member, CRC Committee Physical Sciences Panel 2002

Member, CRC Program Evaluation Steering Committee (Myers Review), 1995

Member, CRC Review Panels 2003-04:

- CRC for Satellite Systems
- Capital Markets CRC
- Smart Internet Technology CRC

Member, CRC Boards:

- CRC for Spatial Information 2004- & Chair 2006-present [on leave through term of NIS Review]
- Australasian CRC for Interaction Design 2004-08 and Chair, Audit Committee 2004-08
- CRC for Power Generation from Low-Rank Coal 1994-96
- CRC for Sensor Signal & Information Processing 1994-96
- CRC for Soil and Land Management 1994-96
- CRC for Water Quality and Treatment 1995-96
- CRC for Weed Management 1995-96
- Petroleum CRC 1994-96

##### Dr Clark

Member, Board of AJ Parker CRC. Dr Clark was a member of this board three times, as a nominee of three different groups.

##### Professor Healy

Member, CRC Committee Physical Sciences Panel, 2002-04

Member, Member, CRC Review Panels 2003-04:

- CRC for Clean Power from Lignite
- CRC for Railway Engineering and Technologies
- Parker CRC for Integrated Hydrometallurgy Solutions
- CRC for Polymers

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## Appendix

### 3 Consultations involving the Review Chair and the CWG

DATE	MEETING
30 Jan	Queensland Department of Tourism, Regional Development and Industry
6 Feb	Margaret Shiel, Jessie Borthwick, Patricia Kelly
13 Feb	CRC Association, Canberra
18 Feb	Australian Research Council
19 Feb	1st meeting CWG, Canberra
22 Feb	NSW Office of Science and Medical Research
28 Feb	2nd meeting CWG, Melbourne
3-7 March	NIS and CRC Review 'Roadshow' Consultations, Brisbane, Darwin, Perth, Adelaide
3 March	Professor Peter Andrews, Queensland Chief Scientist
	Dinner hosted by the Queensland Government and chaired by Professor Peter Andrews (Qld Chief Scientist) with the Smart State Council
4 March	International Summit on Open Access to Public Sector Information, Brisbane
5 March	Dinner hosted by Professor Alan Robson, Vice Chancellor of the University of WA
11-12 March	NIS and CRC Review 'Roadshow' Consultations, Melbourne, Hobart
14 March	NIS and CRC Review 'Roadshow' Consultations, Sydney
17 March	NIS and CRC Review 'Roadshow' Consultations, Canberra
17 March	Dr Ian Watt, Secretary, Department of Finance & Deregulation & Dr Greg Feeney, A/g Division Manager, Industry, Education & Infrastructure
	David Borthwick, Secretary, Department Environment, Water, Heritage and the Arts
19 March	CRC Business Managers – Brisbane
20 March	3rd meeting CWG, Canberra
26 March	Australian Technology Network of Universities – DVCR group, Canberra
	Australian Industry Group, Canberra
27 March	DVCR Group of Universities Australia, Canberra
27 March	Chief Defence Scientist, Canberra
31 March	Professor Donald Stokes, Capital Markets CRC
1 April	NICTA, Sydney
2 April	Senator the Hon Kim Carr, Minister for Innovation, Industry, Science & Research
2 April	CSIRO Business Managers, Melbourne
3 April	Foundations of Open Local 2020 Summit – Senator Kate Lundy
7 April	NSWVCC, Sydney
8 April	Professor Alan Hughes meeting with members of the CWG and some Panel members
10 April	NSW Government agencies
11 April	InterGovernmental Working Group Meeting with CWG, Melbourne
	Victorian Government Agencies
	CWG sub-group meeting, Melbourne
14 April	CSIRO Executive
15 April	IP Australia
	Dr Sally Troy, Department of Environment, Water, Heritage and the Arts
	Universities Australia Board
	Group of 8 DVCRs
16 April	ATO
18 April	CRC Committee
24 April	4th meeting CWG, Melbourne
28 April	Desert Knowledge CRC, NT Government, CDU, indigenous art representatives and Centre for Applied Technology representatives – Alice Springs
30 April	Professor Craig Mudge, NICTA



DATE	MEETING
2 May	Half Day forum by Rural Social Research Group: "Ensuring positive outcomes from technological Developments: Does Australia need Technology Assessment?"
	CWG sub-group meeting, Canberra
6 May	NSW DVC/PVC (Research) with Todd Clewett and Thomas Barlow
8 May	5th meeting CWG, Melbourne
15 May	Lunch with Michael Hartman, CEO, CRC Association
21 May	CRC Association Conference – address to Chairs and CEOs; meetings with various CRCs
23 May	CRC Association closing address; meetings with various CRCs
28 May	Professor Judy Raper, Division of Chemical and Transport Systems, Directorate for Engineering, National Science Foundation, Washington, DC
	World Bank: Alfred Watkins, World Bank Science and Technology Program Coordinator Eija Pehu, Senior Adviser in Agriculture and Rural Development Department
29 May	National Institutes of Health: Dr Alan Krensky, Director, Office of Portfolio Analysis and Strategic and Initiatives, and staff Dr Norka Ruiz Bravo, Deputy Director, Office of Extramural Research Dr Stefano Bertuzzi, Office of Science & Policy
	Dr Michael Hofmann, Executive Director for Germany, World Bank
	Professor Rudolf Haggmüller, Chairman, ITEA 2
5 June	6th meeting CWG, Melbourne
14 June	Alfred Deakin Lecture
17 June	NSW Vice-Chancellors' Committee
20 June	7th meeting CWG, Melbourne
27 June	8th meeting CWG by teleconference
4 July	9th meeting CWG by teleconference
11 July	10th meeting CWG by teleconference
17 July	DVCR Group of Universities Australia, Canberra
18 July	Dr Gerard M Crawley, President, Marcus Enterprises. Formerly with Science Foundation Ireland
21 July	11th meeting CWG by teleconference
29 July	12th meeting CWG by teleconference

## Appendix

### 4 CRC Program Funding and Participant Contributions by Selection Round

**Table 6: CRC Program Funding and Participant Contributions by Selection Round**

These tables show the funding awarded to CRCs under the CRC Grant and the contributions made by Participants by Selection Round. Amounts are given in dollars of the day.

#### CRC Program Funding

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
Total CRC Program Funding	253,762	199,148	175,791	141,647	231,859	410,222	323,191	472,976	414,000	317,844	2,940,440

#### Total Contributions-All Participants

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
Total # Participants	143	156	170	151	173	493	360	468	368	187	2669
Total Cash	93,601	56,747	60,442	54,623	100,628	308,745	218,632	321,146	249,627	185,595	1,649,786
Total In-Kind	497,453	401,210	370,124	327,638	564,402	1,107,050	1,005,351	1,553,451	666,972	648,130	7,141,781
Total Contributions	591,054	457,957	430,566	382,261	665,030	1,415,795	1,223,983	1,874,597	916,599	833,725	8,791,567

#### University (All Australian and International universities)

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of University Participants	37	40	41	39	52	104	87	141	86	43	670
Total Cash	14,671	13,793	26,393	5,417	15,993	39,783	51,843	60,035	46,345	23,108	297,381
Total In-Kind	159,690	152,191	109,074	105,746	167,411	439,065	436,997	644,559	227,326	208,409	2,650,468
Total University	174,361	165,984	135,467	111,163	183,404	478,848	488,840	704,594	273,671	231,517	2,947,849

#### Go8 Australian University

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of Go8 Uni Participants	27	19	21	16	19	55	42	55	37	16	307
Total Cash	11,180	6,848	3,755	2,580	8,571	23,396	28,613	23,282	21,511	3,920	133,656
Total In-Kind	129,665	78,424	58,140	35,257	68,585	254,965	274,125	254,929	102,816	69,871	1,326,777
Total Go8 University	140,845	85,272	61,895	37,837	77,156	278,361	302,738	278,211	124,327	73,791	1,460,433

## Appendix 4 continued

### Non-Go8 Australian University

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of Non-Go8 Uni Participants	10	21	19	23	31	49	45	75	45	26	344
Total Cash	3,491	6,945	4,409	2,837	7,422	16,387	23,230	35,943	24,694	18,838	144,196
Total In-Kind	30,025	73,767	50,934	70,489	97,020	184,100	162,872	353,442	120,622	137,908	1,281,179
Total Non-Go8 University	33,516	80,712	55,343	73,326	104,442	200,487	186,102	389,385	145,316	156,746	1,425,375

### CSIRO

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of CSIRO Participants	18	11	14	9	11	21	14	11	10	5	124
Total Cash	636	847	451	60	2,193	5,255	6,625	1,031	38	-	17,136
Total In-Kind	142,908	92,773	115,374	65,957	95,952	190,979	134,861	100,242	109,133	32,178	1,080,357
Total CSIRO	143,544	93,620	115,825	66,017	98,145	196,234	141,486	101,273	109,171	32,178	1,097,493

### Industry/Private Sector

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of Industry/Private Sector Participants	48	56	74	56	56	224	144	151	154	79	1042
Total Cash	17,900	11,091	18,408	21,008	51,867	134,723	58,125	129,339	99,685	92,053	634,199
Total In-Kind	95,751	50,831	51,108	51,539	124,174	169,146	137,370	327,465	130,934	161,565	1,299,883
Total Industry/Private Sector	113,651	61,922	69,516	72,547	176,041	303,869	195,495	456,804	230,619	253,618	1,934,082

### Industry Association

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of Industry Association Participants	3	3	4	7	7	15	17	19	21	13	109
Total Cash	18,544	15,082	637	18,198	6,937	38,738	62,558	32,343	58,072	49,747	300,856
Total In-Kind	-	687	3,291	6,375	15,228	6,271	9,886	30,221	11,251	22,026	105,236
Total Industry Association	18,544	15,769	3,928	24,573	22,165	45,009	72,444	62,564	69,323	71,773	406,092

## Appendix 4 continued

### Australian Government (excluding CRC Grant funds)

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of Aust Govt Participants	9	13	12	2	8	28	8	22	9	1	112
Total Cash	2,739	5,600	4,527	-	1,440	23,672	4,436	22,823	16,690	-	81,927
Total In-Kind	41,476	27,144	16,280	8,316	29,564	75,777	29,903	96,889	16,069	18,845	360,263
Total Aust Govt	44,215	32,744	20,807	8,316	31,004	99,449	34,339	119,712	32,759	18,845	442,190

### State Government

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of State Govt Participants	18	26	21	32	17	76	64	78	75	29	436
Total Cash	7,469	10,334	9,188	9,415	4,045	39,097	28,734	38,459	26,661	14,089	187,491
Total In-Kind	25,376	60,908	72,465	74,429	54,856	177,839	230,021	184,971	164,564	107,716	1,153,145
Total State Govt	32,845	71,242	81,653	83,844	58,901	216,936	258,755	223,430	191,225	121,805	1,340,636

### Other

Selection Round	1990	1991	1992	1994	1996	1998	2000	2002	2004	2006	Total
Total CRCs	20	17	14	11	16	26	19	21	14	10	168
# of Other Participants	10	7	4	6	22	25	26	46	13	17	176
Total Cash	31,642	-	838	525	18,153	27,477	6,311	37,116	2,136	6,598	130,796
Total In-Kind	32,252	16,676	2,532	15,276	77,217	47,973	26,313	169,104	7,695	97,392	492,430
Total Other	63,894	16,676	3,370	15,801	95,370	75,450	32,624	206,220	9,831	103,990	623,226

