1-1-2004

Scientists, career choices and organisational change: managing human resources in cross sector R&D organisations

Tim Turpin
University Of Western Sydney

Samuel Garrett-Jones
University of Wollongong, sgarrett@uow.edu.au

Kieren Diment
University of Wollongong, kdiment@uow.edu.au

Scientists, career choices and organisational change: managing human resources in cross sector R&D organisations

Abstract

The resource based view (RBV) of the firm has drawn attention to the role of human resources in building innovative capacity within firms. In 'high technology' firms scientific capability is a critical factor in achieving international competitiveness. Science, however, is a costly business and many firms are entering into cross sector R&D partnerships in order to gain access to leading edge scientific capability. The Australian Cooperative Research Centres (CRC) program is typical of the ways many governments are seeking to promote such cross-sector R&D collaboration. Scientists are key resources in these organisational arrangements. However, there is only fragmentary information available about why and when scientists choose to work in these cross-sector organisations rather than others, nor the impact of changing funding regimes on their career choices. Similarly, there has been little research into the impact of such partnerships and career choices on the organisations in which scientists work. This paper presents some findings from two new ARC funded studies in Australia designed to investigate the careers of scientists and the organisational and career implications of participation in cross sector R&D collaboration. One of our findings is that CRCs may not endure as long term 'hybrid' organisational arrangements as some observers have suggested, but rather remain as transitional structure influencing the partners involved and the careers of scientists. This has important implications for the managers of CRCs as well as those responsible for partner organisations.

Keywords

r, sector, resources, human, scientists, change, choices, career, cross, organisations, managing, organisational

Disciplines

Business | Social and Behavioral Sciences

Publication Details

Turpin, T, Garrett-Jones, SE, and Diment, K, Scientists, career choices and organisational change: managing human resources in cross sector R&D organisations, Proceedings of the Australian & New Zealand Academy of Management Conference, 8-12 December, 2004, Dunedin, New Zealand: Australian and New Zealand Academy of Management.

18th Annual Conference of the Australian and New Zealand Academy of Management

Dunedin December 8th – 12th 2004

Scientists, Career Choices and Organisational Change: Managing Human Resources in Cross Sector R&D Organisations

Proposed for Stream K

Authors

Tim Turpin,
Australian Expert Group in Industry Studies (AEGIS)
University of Western Sydney

t.turpin@uws.edu.au

Sam Garrett-Jones and Kieren Diment
Univerisity of Wollongong

sgarrett-Jjones@uow.edu.au

kdiment@uow.edu.au

Scientists and Career Choices:

Managing Human Resources in Cooperative Research Centres

Abstract

The resource based view (RBV) of the firm has drawn attention to the role of human resources in building innovative capacity within firms. In 'high technology' firms scientific capability is a critical factor in achieving international competitiveness. Science, however, is a costly business and many firms are entering into cross sector R&D partnerships in order to gain access to leading edge scientific capability. The Australian Cooperative Research Centres (CRC) program is typical of the ways many governments are seeking to promote such cross-sector R&D collaboration. Scientists are key resources in these organisational arrangements. However, there is only fragmentary information available about why and when scientists choose to work in these cross-sector organisations rather than others, nor the impact of changing funding regimes on their career choices. Similarly, there has been little research into the impact of such partnerships and career choices on the organisations in which scientists work. This paper presents some findings from two new ARC funded studies in Australia designed to investigate the careers of scientists and the organisational and career implications of participation in cross sector R&D collaboration. One of our findings is that CRCs may not endure as long term 'hybrid' organisational arrangements as some observers have suggested, but rather remain as transitional structure influencing the partners involved and the careers of scientists. This has important implications for the managers of CRCs as well as those responsible for partner organisations.

Introduction: a resource based view of CRCs.

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

Research scientists in this context work in quite complex and often novel organisational arrangements that depend on cooperation between interdependent parties. The interests, objectives and strategies among the parties, however, may conflict or converge (Hellstrom and Jacob, 2000, 99). Ambiguities or ambivalence associated with such cooperation can emerge between individuals as well as between organisations within the cross-sector cooperative arrangement. Managing such ambiguities can become a difficult but pressing task.

This paper is concerned with the human resource aspects of this task. In particular, our focus is on the tensions and ambiguities that drive career expectations and choices of research scientists and the organisational tensions created by the different institutional objectives and expectations of the partner organisations. Our analysis draws on data collected through two new studies in Australia. Institutional experiences and responses to cross sector R&D arrangements were collected from senior university research centre managers over a three year project (Managing the Risk in Cross-Sector R&D Collaboration, Turpin, Garrett-Jones, Fulop and Couchman, 2002-04). The experiences, expectations and opinions of a sample of 520 'research active' scientists in Australia were gathered through a separate study carried out through 2003 to 2004 (Innovation Agents and Innovation Tracks, Marceau and Turpin, 2002-3).

One of our major findings at this stage is that the Cooperative Research Centres in Australia seem to have reached a critical stage in development. Structural tensions between institutional partners combined with the expectations and career choices of scientists are raising questions about long term management and sustainable cooperative arrangements. These can perhaps be resolved in the short-term, but in the longer term CRCs and institutional partners may need too implement quite different human resource management strategies.

The focus of strategic management literature has shifted recently from environmental (industry/market) determinants to resource-based factors, that reside within the firm, in the search for superior performance (see Zhang 2004). The core claim of this 'resource based view' is that idiosyncratic internal resources/capabilities rather than industry structure are the determinant of superior firm performance. In particular, this view perceives the firm as a unique bundle of idiosyncratic resources and capabilities heterogeneously distributed across firms (Eisenhardt and Martin, 2000; and Zhang 2004). Resources can be created within the firm and they may refer to tangible assets (such as technology and intellectual property) or intangible assets (such as creative technical or scientific skills and knowledge). In a recent study by Zhang of over 3000 firms in China her findings clearly revealed that it is the way these resources are internally packaged (mixed and matched) rather than the strength of a particular resource (Zhang, 2004).

Although the resource-based view of the firm emphasises firm-specific capabilities a specific capability depends on industry characteristics and expectations that determine the 'value' of the resource. For example, manufacturing capability is valuable in industrial sectors but it may not be so valuable for firms in service industries. Cross-sector R&D partnerships introduce a variety of characteristics and expectations. A common feature is the sharing of scientific expertise embedded in individuals and teams of researchers. However, as the present paper reveals, the organisational context and the ways the scientists are *expected* to work creates ambiguities and tensions not just for the scientists themselves, but also for the partner organisations with which they work. To the extent that scientists outputs are considered as a shared resource their career choices carry some resource implications for all CRC partners albeit some more than others. Managing these tensions within organisations requires an understanding of the career experiences and employment choices of scientists. Scientists in this context are faced with a wide range of expectations, imperatives and choices. They are no longer driven simply by the creative demands of science (if indeed they ever were) but face a range of contemporary pressures from well outside the traditional realm of science (Bun and Chung, 2003). Following Zhang's observations it is important to know the underpinnings of these imperatives in order to match this critical 'shared' scientific resource with other internal firm capabilities held by partner organisations.

The Australian CRC Program: the organisational interface

The Cooperative Research Centres Program (CRC Program) represents the Australian Government's largest single investment in cross-sector (industry-university-government) R&D collaboration. It is widely credited with 'changing research cultures' and promoting increased and more effective cross-sectoral, multidisciplinary and multi-organisational research, technology development and commercialisation (Roberts, 2004). Yet how, to what extent, and in what areas scientists have contributed to organisational change, or how organisational change has influenced scientists' career opportunities has been very much under researched (Bozeman and Wittmer, 2001; Garrett-Jones and Turpin, 2002).

The CRC program was first established in 1990 with the objective of building closer relationships between Australian science and industry. The program is primarily oriented toward industrial research and development across a range of sectors including agriculture, fisheries, forestry, information and communications, manufacturing, mining, energy, medicine, water services, transport and construction. However, the program also includes Centres focused on public good outcomes including public and environmental health, sustainability and maintenance of biodiversity (Howard Partners, 2003).

A feature of the CRC program is that it requires the formation of *structured* and *managed* relationships between organisational partners, including universities, government agencies, research institutes and private firms. Management plans must be clearly developed and articulated in submissions for joint funding between

the Commonwealth Government and the participating research partners. Up to June 2002 the Commonwealth Government had contributed $1.5 billion in program funds with partners contributing $680 million. These funds, together with 'in-kind' contributions from partners, including salaries and equipment, have provided a total level of funding in access of $4.5 billion. This level of investment has enabled the CRC program to hold '… extraordinary sway' in Australia's science and technology community (Roberts, 2004:52).

Over its ten year existence, the CRC Program has been exposed to several major reviews. Recent program evaluation reviews have emphasised the role of the program as a national policy instrument for building closer relationships between science and industry and the role of centres as agents of change. The latest review, carried out in 2003, argued that as the program has evolved three distinct types of CRC have emerged: those focused primarily on building national resource sustainability; those focused primarily on improving industry performance; and those leading to new business development and the commercialisation of intellectual property. The review team argued that with this evolution there is a need to position the program as a 'vehicle in which research is seen as a means to an end, not an end in itself.' (Howard Partners, 2003, iii). Their argument was based on their analysis that CRCs are, in practice, now limited in the extent to which they can improve the match between technology push and demand. Their recommendation was that CRCs must more effectively respond and adapt to the wider structural changes in the science and innovation system and the pathways between industries and technologies. This implies a greater emphasis on and consideration of the centres' management objectives and strategies.

Our analysis supports this view to some extent. We certainly agree that the program has reached a critical stage in development. However, we are cautious about making recommendations for change that carry implications for management approaches without a much clearer understanding of what currently motivates and drives the key component in Australian science - the researchers themselves. Our analysis of the experiences and opinions of Australian scientists and research managers, including those currently working in CRCs and their partner organisations raise some important structural observations. One of the more significant of these is that CRCs are perhaps not evolving as long term organisational arrangements, but rather transitional structures serving the short-term interests of organisations as well as the careers of scientists.

Our finding is that scientists currently working in Australia face a complex set of imperatives and ambiguities concerning career choice. On the one hand, they seek to be at the leading edge of science. Many, but not all, are also seeking to be involved in the process of applying leading edge science to contemporary industrial and environmental problems. The CRC program has provided a 'front-end' focus for both of these activities. However, the nature of CRCs provides a considerable level of uncertainty in terms of research funding and consequently employment. There is thus a certain level of ambivalence with which scientists make career choices. The options appear to be: either taking on a risky but research intensive and exciting option; or retaining a safe but research limiting and more 'pedestrian' option. This ambiguity and its implications for human resource management needs to be fully understood in considering the future of the program. The long-term strategic objectives of centres and the career aspirations of scientists need to be in some reasonable state of symmetry. This raises challenges for the managers of the program as a whole as well as managers at the CRCs interface between universities, industry and public research institutes.

Organisational Tensions: a collaborative risk

There is growing evidence that CRC host institutions are quite deeply affected by their involvement in CRCs. The intrusion of commercial markets has placed different pressures on university research networks as their institutions adopt commercial business practices (Marginson, 1994). Some researchers have proposed that

industry university research collaboration in commercially oriented activities has the potential to confuse the university's central commitment to the pursuit of knowledge and learning generally (Coady, 2000). Others have suggested that a decline in basic research and associated secrecy commitments in industry collaboration may undermine the innovation process (Feller, 1997). Slaughter and Leslie (1997) in describing university change adopt the term 'academic capitalism', because it captures the inherent clash in cultures and value systems. They note that since the 1980s, globalisation has accelerated movement toward the market. These are deep-seated changes, they argue, '…where professional work began to be patterned differently, *in kind* rather than in degree' (Slaughter and Leslie,1997, 5). Ziman (1994) has proposed that the structural nature of these changes are such that it now makes sense to refer to 'post-academic science'. Others have argued that the changes are so profound that they represent a new mode of knowledge production (Gibbons *et al*). Alternatively, Etzkowits and Leydesdorff have theorised that negotiated alliances between universities, governments and industry have led to what they describe as a 'triple helix' of knowledge production. Underlying all these perspectives is the recognition that relationships between academic disciplines, universities and industry are undergoing radical transformation. What does this mean for the scientists and postgraduate research students that work at this interface? In all this theorising little attention has been paid to what such changes mean for the careers of scientists or to the ways that scientists themselves might be contributing to the 'reorganisation' of science.

Behrens and Gray have considered the organisational *cost* of cooperative arrangements (Behrens and Gray 1999, 180). They have been concerned to document *unintended* consequences of collaboration through changes in social process. They have collected empirical data to assess the impact of university – industry collaboration on graduate training. One of the more difficult concepts they seek to bring to the fore is *organisational climate*. In particular, they are concerned with questions such as *how* and *under what circumstances* the organisational climate has changed and whether or not this has led to intended or unintended outcomes.

Recent work by Bozeman and colleagues suggest that a wide range of factors determine satisfactory outcomes for partners. They point out that it is not the act of technical partnership that should be considered effective or otherwise, but rather the technical strategy that underlies the partnership. This turns the focus onto business and organisational strategies and the effective management of human resources (Bozeman and Wittmer, 2001). Bozeman's team has tracked the careers of scientists in American academic research centres by collecting and analysing scientists' curriculum vitae. This methodology, although useful for tracking mobility, does not answer the question of *why* people choose to move nor how they experience the changing environment in which they work.

A Typology of Risk and Management Issues for CRCs

Decisions about career change generally require some trade-offs between potential costs and benefits. Some level of risk is encountered in making such choices. The management and organisational studies literature has generally tended to focus on four types of risk: 'strategic risk'; 'financial risk'; 'managerial decision making risk'; and 'project management risk' (Baird and Thomas, 1985; McNamara and Bromley 1999). Our recent interviews with research managers in CRCs and senior managers in institutional partner organisations suggest that within CRCs three quite distinct types of career risk are encountered by scientists. We have categorised these as academic risk, scientific risk and organisational risk.

Academic risk

Academic risk concerns the risk experienced by researchers in their role as academic employees. Opportunities

for career advance and mobility are subject to what we define here as 'academic risk'. [2] As Ziman pointed out quite some time ago, in academic markets only a small proportion of the competent researchers in a particular field will contribute to real progress in the field (Ziman, 1994). The risk that academics take in joining different research groups or networks is whether they will be in a collective position to be part of that small proportion. However, there are clearly perceived career advantages for new or young researchers.

As one Head of School put it to us:

> The CRCs are a mechanism to draw people and success together and win funding, especially for younger researchers allowing them to get up and running (Interview, 2003).

Other respondents noted longer term career benefits: … 'out of the CRC it can be a somewhat lonely place. The CRC offers a collaborative culture between student and other partners – an encounter with the real world' (Interview, 2003). Another respondent drew attention to the opportunities within CRCs for researchers to share in the commercialisation of IPR.

> The rub for the researcher in a university was that the institution controlled the share of IP and a relatively smaller portion would go to the researcher as an academic and still less to a student. In the CRC the Board makes these decisions (Interview CRC CEO, 2003).

Consistently, CRC respondents drew attention to the value of teams and networks of partners that offer opportunities for researchers to extend their careers. But while there are clearly career benefits in the CRC structure there are also disadvantages associated with the short-term nature of funding. There is always the potential for contracts to draw to a close leaving some researchers to take up alternative positions offering little in terms of future career advancement. Others drew attention to the risk that long-term involvement with CRCs can leave scientists with a narrower focus: 'A focus on specific products can lead to narrowing down in the framing of objectives. It is a progressive exercise – with risk' (Interview Head of School, 2003).

Scientific risk

We use the term scientific risk to refer to the risk of change in the disciplinary structure of research and the organisational domains within which the disciplines are variably located. The issue of interdisciplinarity and implications for disciplinary boundaries has been widely discussed elsewhere (Stehr and Weingardt, 2000). Our use of the term here is to draw attention to the struggles within university structures around disciplinary boundaries and the way these are managed within the university (Turpin, 1999). The risk of supporting a new and different set of research values and norms is that they may come to dominate existing academic values and expectations. As a consequence the objectives and focus of research and the ways it is judged may change in intended or unintended ways.

In the CRC context a number of respondents from Departments and Schools complained that many of their best researchers had little time left to contribute to Faculty directions. 'The result is an erosion of a department' (Interview, 2003). This was described by another respondent as a 'hollowing-out' of research expertise, especially with an exodus of doctoral students to other CRC locations. On the other hand one CRC CEO drew attention to what she described as a loss of intellectual edge among some new researchers, …'once they enter CRCs some post doctoral researchers become somewhat lethargic. As another respondent put it, '… there is a danger of their narrowing down in focus'. Thus while some respondents described CRCs as exciting and stimulating team based environments, others were concerned about researchers' potential loss of impetus

and research breadth. In the concluding sections of this paper we return to these sorts of ambiguities. In career terms, just as there are costs and benefits there are also potential winners and losers.

Organisational risk

Organisational risk refers to the potential shift in organisational boundaries occurring through the collaborative research process. There is an organisational risk that certain strategic actions might introduce unintended and adverse consequences and that these disturb the organisation's internal environment, performance and goals. These boundary movements can be positive or negative depending on one's point of reference. If the risk is obvious then organisations can adopt risk management policies. Indeed most organisation, including universities, do this. However, our concern is more with risk from collaborative arrangements that are unknown or at least poorly understood.

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

In the Australian CRC context there is growing evidence of a struggle over maximising 'value' among organisational participants.

> Who goes into the CRCs is important – key individuals *jump ship*. In the middle is the Department head who is pushed and pulled by the university management and by the researcher. It's probably better to have the research 100 per cent in the centre rather than a 50-50 arrangement (Interview with CRC CEO, 2003).

And from another point of view, this time a deputy Vice Chancellor, the tension is to be able to maximise the institution's derived value while minimising the cost.

> The problem for universities is how to best win value from such combinations of industry and universities. …Our Dean is now looking closely as the value of participating in any CRC for the dollar returns. So too are the heads of five departments. It is about control to win value - value in terms of the impact of outcomes on the faculties as against the university's overall points for successful participation (Interview, 2003).

These tensions and risks have been documented in various ways elsewhere (see Illing, 2004). Our analysis over the past three years suggests that in many cases the tensions are increasing to the point where participants are making serious assessments about whether to remain in the partnerships. Australia's largest research institution, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) one of the major CRC participants has already made strategic decisions to reduce their level of involvement in many CRCs. University Pro-Vice Chancellors are becoming increasingly vocal and proactive in terms of strategic action to win value. Some universities have already showed signs of withdrawing from CRCs unless they can identify greater value returns for *their institution* overall. A number of PVCs responsible for research have recently been quoted as indicating their possible withdrawal or at least 'reconsidering' their involvement in CRCs (Illing, 2004) This seems to suggest that the potential of CRCs to emerge as an enduring 'hybrid' form of

organisation may already have reached its limit.

It is in this context that we are concerned to know how these tensions impact on the careers of scientists. How do scientists respond to these ambiguities and tensions? When they make choices to leave a university department to join a CRC, whether on secondment or on a contract appointment, what are their expectations? What are their views about the science policy that is steering the availability of options? What are the constraints they experience? These are all important questions for managers and policy makers concerned with cross sectoral organisational arrangements.

In the following section we report on a survey of Australian scientists carried out through 2003. The survey identified a sample of 2,400 publishing scientists from Australian institutions drawn from the ISI Web of Science data base. An on-line survey instrument was constructed drawing on previous work of Sommer in New Zealand and the US (2000) and Bozeman *et al.* at the Georgia Institute of Technology in the US (2001). The major objective of the survey was to track the carer paths of scientists and identify the nature, extent and mechanisms of contributions to innovation in Australia. In this paper, we are reporting on two aspect of the data collected in that survey: their reasons for changing jobs; and, their perceptions about contemporary science issues and the role of science, government and society in their on-going research activities.

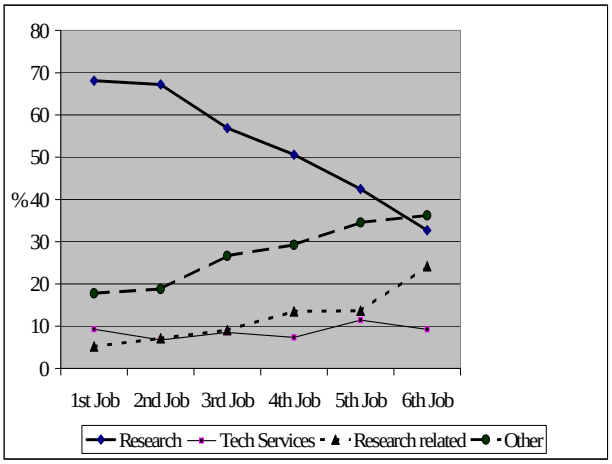
Scientists' Careers: research or job security – a dilemma.

Changes in research activity

Data drawn from our survey of scientists show a very clear erosion of time allocated directly to research activity as they progress through successive jobs. As figure one shows, respondents' average time spent on research in their first job was just under 70 percent. However, with each successive job this proportion reduces progressively to barely 30 percent by the sixth job. Significantly, in all current jobs the proportion of time spent on research is still only 46 percent (including those still in their first job). Obvious explanations for this erosion of research activity includes increased teaching commitments for academic staff and increased management or administrative responsibilities as scientists progress to more senior positions.

For respondents currently working in CRCs there is clearly more time available to devote to research. This group of respondents report contributing an average of 61 percent of their time to research. In the light of comments from CRC managers this is largely a factor of the greater distinction placed on research and management activities and responsibilities in CRCs. In universities, by contrast, administrative, reporting and management tasks are increasingly being pushed down the line to individual academics. The sharper distinction between management and research responsibilities in CRCs presents a more clearly defined 'dual ladder' career path for researchers (see Chaterji, 1993) or variations on that trajectory (Turpin and Deville, 1995). On this basis scientists in CRCs are better placed to identify clearer options toward alternative career pathways. As we discuss below, the perspectives and opinions of CRC respondents concerning science and its management suggest a more positive approach to career options.

Figure One: The Decline of Research Compared to Other Activities Through Career Progression



Source: Scientists Survey 2004

Reasons for changing jobs

Respondents were all asked to nominate their major reason for changing jobs. They were asked to nominate the major reason from within one or more major categories: 'science reasons'; 'employment reasons'; or 'other reasons'. The most frequently nominated category was opportunities for improving general employment conditions (90.0 percent), particularly improved salary and promotional opportunities. Almost all CRC respondents identified an employment reason as their prime reason for changing jobs. The second most common reason for job change concerned scientific related reasons (80.7 per cent), particularly greater research autonomy, and access to better research infrastructure. Other reasons were nominated by 63.2 percent of respondents, mainly family reasons and geographic location (37 percent and 22 percent respectively). The range responses to 'other reasons' support the view of Bun and Chung (2003) that external factors are important for scientists just as they are with other employees.

Perceptions of science and society

All respondents were asked to indicate what they considered to be the most pressing issues facing scientist today. The major issue that emerged was an overwhelming concern about funding (see Table One). Eighty four percent nominated access to longer term research funding as the most pressing issue. Thirty seven percent identified an emphasis on applied funding over basic research, the major issue. The third strongest issue concerned a lack of public understanding of S&T (34 percent).

Table One: Major Issues Facing Scientists Today

Major Issue	**ALL n=515**	**CRC n=18**
A lack of public understanding of S&T	34.4	22.2
Access to longer term research funding	83.5	83.3
Politicising of scientific research	22.9	22.2
Access to infrastructure and equipment	26.8	11.1
Emphasis on funding applied over basic research	37.1	27.8
Management and accountability requirements	23.1	16.7
Ownership of research issues	6.6	16.7
Controversial nature of cutting edge science	4.7	16.7
Emphasis on commercialisation over peer based reviews of excellence	28.5	27.8

Source: Scientists Survey 2004

Respondents were asked to indicate their agreement, or otherwise, along a five point scale, with a set of 25

statements concerning science, government and society. These items have been replicated and adapted from earlier work carried out by Sommer in New Zealand and provide a useful point for international comparison. However, for the present paper we are interested to contrast the responses of Australian scientists overall with a smaller sub-group of scientists working in CRCs.

The results shown in Table Two show the proportions agreeing or agreeing strongly to each statement as well as the mean scores for ‘all respondents and the CRC respondents. The scoring for each item is based on a score of 1 for strongly agree through to a score of 5 for strongly disagree. Thus the lower the score, the stronger the level of agreement with the statement.

Although a comparatively small numbers of CRC respondents were included in the analysis they are nevertheless indicative and reflect some consistent differences in opinion from the broader sample. These distinctions, although based on small numbers, are entirely consistent with many of the observations noted by research managers and reported in the previous sections, drawn from a separate study. Overall the CRC respondents present a more positive attitude to contemporary science policy and directions (items 5, 9, 21, 25) a more integrated perspective of science and society (items 1, 3, 4, 8) more positive response to their current research position and environment (items 13, 18 , 19) ***but*** a considerably higher level of concern about job security over the next five years (item 17). In the concluding section of this paper we discuss this apparent ambiguity and some of the policy and management implications that follow. This issue is currently being explored through a more broadly based survey of CRC researchers and research managers across the entire CRC program.

Table Two: Science Values, Government and Society

Science issue	ALL n=515	CRC n=18	All n=515	CRC n=18
	% agree or agree strongly		Mean	
1. Prior to conducting scientific or engineering R&D or developing new products, I always consider the potential uses of such work.	**64.2**	**88.2**	**2.36**	**1.82**
2. I think that the development of potentially dangerous technology should be decided primarily within the scientific and engineering community	**16.1**	**23.5**	**3.75**	**4.06**
3. I think the implementation of potentially dangerous technology should depend primarily on citizen input through voting processes and public debate.	**35.5**	**52.9**	**3.14**	**2.82**
4. I believe the pursuit of scientific knowledge transcends national concerns	**50.8**	**47.1**	**2.67**	**2.82**
5. The proper role of government with regard to the funding of science is to define broadly what should be investigated, thereby providing scientists with a research agenda	**20.2**	**52.9**	**3.74**	**3.24**
6. When government sets research agendas, it is responding more to political priorities than it is to potential for scientific advance	**86.3**	**88.2**	**1.81**	**2.06**
7. When taxpayers fund basic/fundamental research, their government representatives cannot require a specific payoff because no scientist can guarantee a result in advance of doing research	**84.0**	**75.0**	**1.85**	**2.19**
8. The public can be trusted to make good decisions on science-related issues	**8.2**	**11.8**	**3.83**	**3.56**
9. All things considered, government science policy is headed in the right direction	**11.5**	**5.9**	**3.71**	**3.59**
10. From what I know of scientific discovery, it is more a result of insight and circumstance than it is of application of a standard methodological treatment of a subject area	**60.2**	**52.9**	**2.46**	**2.56**
11. Most of the really interesting research questions today require expensive state-of-the-art scientific equipment to answer them	**26.4**	**17.6**	**3.38**	**4.0**
12. In my professional capacity, I feel responsible first to science and the creation of new knowledge or products and then to the concerns of citizens	**31.6**	**17.6**	**3.25**	**3.47**
13. My access to equipment, facilities and other scientific research supplies has improved over the past two years	**42.5**	**41.2**	**3.13**	**3.29**
14. During the past two years, I have participated in or directly witnessed an effective collaboration between social scientists and physical scientists	**27.3**	**41.2**	**3.26**	**3.06**
15. During the past two years, I have participated in or directly witnessed an effective collaboration between industry-based and university-based research scientists	**66.9**	**64.7**	**2.29**	**2.50**
16. The way things are going with scientific and engineering careers in Australia today, I would recommend such careers to Australian youth	**66.9**	**64.7**	**3.41**	**3.31**
17. I feel that my job is reasonably secure for the next five years	**47.0**	**5.9**	**3.09**	**4.29**
18. During the past two years, my job satisfaction has risen	**33.8**	**47.1**	**3.24**	**3.06**
19. The introduction of the CRC program has been beneficial for research in my field	**33.4**	**82.4**	**3.02**	**1.44**
20. I am able freely to submit my research results for publication	**83.9**	**76.5**	**1.89**	**194**
21. The management systems now in place are appropriate for the effective advancement of collaborative research	**26.1**	**58.8**	**3.27**	**2.76**
22. My freedom to collaborate with scientists outside my own institution has remained satisfactory or increased over the past two years.	**71.4**	**76.5**	**2.25**	**2.12**
23. Changes in the organisation of tertiary education over the years have created or are creating a better environment for scientific research	**5.9**	**11.8**	**4.18**	**3.87**
24. Block funding for public sector research institutions is essential for the long-term relevance of their work in Australia	**63.3**	**50.0**	**2.20**	**2.25**
25. All things considered, science in Australia is headed in the right direction.	**15.7**	**35.3**	**3.58**	**3.06**

Source: Scientists Survey 20

Cooperative Research Centres - a staging post or corral?

Our analysis of scientists' and research managers' responses to contemporary science and science policy issues leads us to propose that CRCs provide an opportunity for scientists to escape the management and administrative burden in their traditional organisational arrangements to spend more time on research (especially collaborative research) in CRC types of organisation. The CRCs offer well funded but more short-term employment opportunities compared to tenured existence at universities or research institutions). It is not surprising that there is congruence between the concerns of some department heads that their research is being 'hollowed-out by the CRCs' recruitment of many of their top research staff and students' and the level of

satisfaction expressed by scientists who have made the 'jump'. Scientists seeking to leave a departmental structure to accept a CRC position or 'jump', as one university manager put it, appear to be making a trade-off: accepting limited term employment security for a more research intensive option with closer links to 'research-users'.

The distinction between concerns about the capacity of tertiary education to provide an environment conducive to scientific research (low on all accounts but particularly for those not at CRCs) and the endorsement of CRCs (particularly for those at CRCs) as being beneficial for respondents' research, suggest the sharp edge of organisational change.

To some extent CRCs are viewed, from a policy perspective, as agents of change to facilitate 'appropriate' responses among universities. There has been much debate in this context about whether new of 'hybrid' organisational structures are emerging and if so what this means for science. We are more concerned to know what this means for scientists and research managers responsible for the organisations in which they work.

From our analysis, at this stage, we suggest that CRCs are serving as 'stepping-off' points for many new, and older research staff seeking a more research-intensive career than they enjoyed in previous organisational environments. Their opportunities for long-term employment in the new context, however, are limited. So long as the centres serve as a staging post for further career choices, the longer-term prospects for the organisation are perhaps not so important. On the other hand if research careers in CRCs continue in the long–term there is always the potential to become *corralled* by the short-term objectives driven by short term funding.

From a policy point of view it will remain important to monitor the impact of CRCs on the careers and mobility of research staff, including doctoral and post doctoral research fellows. So far, there is little evidence that this is seen as a serious item to monitor in evaluation mechanisms. Scientists are clearly key resource for CRCs influencing their capacity to deliver social and economic returns from public and private investments. A resource based view of CRCs brings this factor to the fore in evaluation and management processes.

A further point worth noting is that life style choices were clearly important factors in the career decisions made by scientists, but so too were scientific and general employment conditions. It would appear that when these coincide there is a very strong imperative for scientists choose to 'jump' ship'. This has important implications for managers across all particpant organisations because they are in a position to set in place creative mechanisms to reduce the sorts of tensions described earlier in this paper.

One way to resolve some of the tensions between CRCs constituent partners would be to introduce greater flexibility into the career options for scientists as they choose between working in different sectors or in cross-sectoral arrangements such as CRCs. Employment contracts in CRCs appear to offer limited long term opportunities but considerable short-term attractions. Flexible and creative recruitment policies such as increased opportunities for secondments across sectors and institutions or joint appointments offer a range of options for resolving some of the tensions.

Two options seem to appear for policy makers. Either seek to develop more flexibility in the system to enable scientists to move more freely across private, university and public sectors or further strengthen the CRC program as a longer-term hybrid organisation. Given the growing concerns expressed by university and research institution managers and their caution toward extending investments in CRCs this latter approach will carry significant challenges for current funding arrangements. The greater national and scientific benefit is likely to accrue when CRCs can ebb and flow in their objectives and strategies as demand and funding opportunities permit but at the same time serve as a staging post for scientists through a variety of stages in their scientific careers.

References

Baird, I. and Thomas, H. (1985) 'Towards a contingency model of strategic risk taking,' *Academy of Management Review*, 10:230-243.

Behrens, Teresa R. and Denis O. Gray, (1999) 'Unintended consequences of cooperative research: impact of industry sponsorship on climate for academic freedom and other graduate student outcome', *Research Policy*, 30, pp. 179-199.

Bourdieu, Pierre (1988) *Homo Academicus*, Polity Press, Cambridge, UK.

Bozeman, Barry and Dennis Wittmer (2001) 'Technical roles and success of US federal laboratory-industry partnerships, *Science and Public Policy*, Vol. 28, No. 4, June 2001, pp 169-178.

Bun and Chung, 2003

Chaterji, D. (1993) 'Emerging Challenges for R&D executives – an American perspective' *R&D Management*, Vol. 23, No. 3, 239-47.

Coady, Tony, *Why Universities Matter*, Tony Coady, (ed.) Allen and Unwin, Melbourne, 2000.

Combs and Ketchen (1999)

Etzkowitz, Henry and Loet Leydesdorff (eds.), *Universities in the Global Knowledge Economy: A Triple Helix of Academic-Industry-Government Relations* (London: Cassell, 1997).

Feller, I (1997) 'Technology Transfer from Universities' in J.C. Smart (Ed.) *Higher Education Handbook of Theory and Research*, Agathon Press, New York.

Garrett-Jones, Sam and Tim Turpin.(2002) Measuring the Outcomes of the CRC Program: A Framework - Final Report'. Dept. of Education, Science and Training, May 2002. http://www.crc.gov.au/Docs/pdf/Outcomes_Study_text.pdf

Gibbons, Michael, Camile Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott and Martin Trow, *The New production of Knowledge: The Dynamics of Science and Research in Contemporary Societies* (London: Sage, 1994).

Hellstrom, Tomas and merle Jacob (2000) 'Emerging Issues in R&D Evaluation: The Case of University-Industry Partnership Networks, in Merle Jacob and Tomas Hellstrom (Eds.) *The Future of Knowledge Production in the Academy*, The Society for Research into Higher Education and Open University Press, pp. 95-105.

Hill, Stephen and Tim Turpin, (1995) Cultures in Collision: The Changing Face of Academic Research Cultures, in Marilyn Strathern (ed.), *The Uses of Knowledge: Global and Local Relations. The Reshaping of Anthropology, Volume 1 - Shifting Contexts*, London, Routledge,.

Howard Partners (2003) Evaluation of the Cooperative Research Centres Programme, Department of Education, Science and Training, Canberra.

Illing, Dorothy, (2004) 'Unis buck at rising project dollars', in *The Australian*, Higher Education Supplement, 31st., March 2004.

Marginson, Simon (1994) 'Markets in Higher Education: Australia', in J. Smyth (ed.), *Academic Work* (Buckingham: Open University Press.

McNamara, G. and Bromley, P. (1999) 'Risk and return in organisational decision making,' *Academy of Management Journal*, 42:330-339

Nooteboom, Bart (2000) 'Institutions and Forms of Co-ordination in Innovation Systems, *Organizational Studies*, Vol. 21, No. 5, pp. 915-939.

Nowotny, H. Scott, P. and Gibbons, M. (2001) *Re-thinking Science: Knowledge and the Public in an age of Uncertainty*, Polity, London.

Roberts, Peter (2004) 'It's the end of an era for CRC influence', in *Australian Financial Review*, Feb 2nd. 2004.

Rogers Juan D., (2001) 'Software's "Functional Coding" and Personnel Mobility in Technology Transfer: Linkage Fields between Industry and Publicly Funded Research', Research Paper, School of Public Policy, Georgia Institute of Technology, Atlanta.

Slaughter, Shiela and Larry L. Leslie, *Academic Capitalism: Politics, Policies and the Entrepreneurial University*, Baltimore: The Johns Hopkins University Press, 1997.

Sommer, Jack (2000) 'Year 2000 Survey of Scientists: report of Results, The University of North Carolina at Charlotte, NC, Project Report, 2000.

Stehr, Nico and P. Weingardt (2000) (eds.) *Practising Interdisciplinarity*, Toronto Press, 2000.

Turpin, Tim, and Adrian Deville, (1995) 'Occupational Roles and Expectations of research scientists and research managers in scientific research institutions', in *R&D Management*, Vol. 25, No. 2, 141-157.

Turpin Tim (1999) 'Managing the Boundaries of Collaborative Research: a contribution from cultural theory', in *International Journal of Technology management*, 18 (3) pp. 232-245.

Van der Walt, Tjaart and William Blankley (1999) 'South African strategies for the promotion of research and

technology innovation: Towards effective collaboration and new business development, *Industry and Higher Education*, February 1999.
Weingardt, Peter, and Nico Steher (eds.) (2000) *Practising Interdisciplinarity* University of Toronto Press, Toronto.
Zhang, Jing (2004) The Impact Of Innovation Capabilities On Firm Performance: An Empirical Study On Industrial Firms In China's Transitional Economy, Doctoral dissertation, University of Wollongong.
Ziman, John (1994) *Prometheus Bound: Science in a dynamic steady state,* Cambridge University Press.
Ziman, John (1996) '"Postacademic Science": Constructing Knowledge with Networks and Norms' in *Science Studies*, 1.

Acknowledgements

We wish to acknowledge the Australia Research Council for providing two Discovery grants to support the research on which this paper is based and our colleagues Professor Jane Marceau and Dr Richard Woolley from the University of Western Sydney, Professor Liz Fulop from Griffith University and Associate Professor Paul Couchman from the University of Wollongong..

---

[1] The CRC Association now holds annual meetings that are widely attended by senior policy advisors, among others, and focus on key national and international research policy debates.

[2] Our use of the term draws on Ziman (1994) and Bourdieu (1989) although we use the term somewhat differently here.