Inter-Occupational Innovation: an Exploration of Commercial and Research Occupational Subcultures Within Hybrid Industry-Research Organisations.

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I dedicate this work to the researchers and managers working in Australian CRCs.

I admire their efforts tremendously and am grateful for their generosity and openness. This research tells their story and without their permission and support, it would not exist.
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The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in whole or in part, for a degree at this or any other institution.

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Kathryn Janet Hayes
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Abstract

Keywords: organisational culture, occupational subcultures, innovation, commercialisation

This study explores perceptions regarding the existence and influence of occupational subcultures on commercialisation outcomes in four Australian hybrid industry-research organisations.

Hybrid industry-research organisations pose a number of challenges to the individuals who work in them. One challenge consists of operating within an organisational cultural paradox; the beliefs, values and assumptions held by groups within the organisation are seemingly contradictory and yet valid. The thesis proposition is that occupational subcultures exist within Australian Cooperative Research Centres (CRCs) and impact commercialisation outcomes; the distinctly different knowledge and skills that provide reason for research and commercial groups to collaborate, may simultaneously create obstacles to communication and cooperation. Understanding and considering the impact of occupational cultures that underpin the actions and decisions taken by member organisations and individuals, may be important in hybrid industry-research organisations.

Previous work concerning the experience of working in Australian CRCs has mainly examined the perspective of scientists and other researchers. Studies providing equal representation of industry based, commercial participants are rare. Evidence from exploratory interviews led to the proposition that forms the basis of the research; that individuals import their occupational cultures into the CRC organisation. Martin’s (2002) theory of three perspectives of organisational culture provided theoretical grounding for the study. An improved understanding of the occupational cultural schemas operating in CRCs is required to make recommendations to reduce the tension, frustration and conflict reported by respondents.
Exploratory, qualitative research of the thesis proposition identified several variables viewed by CRC members as contributing to inter-occupational tension. Theoretical propositions based upon CRC participants’ descriptions of their experiences of occupational subcultures, including the influence and management of occupational subcultural boundaries, are developed. The research design uses retrospective and longitudinal semi-structured interviews with twenty individuals recruited from four CRCs. Exploration of the research questions occurred through collective case research that compared organisations of different age and size, drawn from two industry sectors.

This study finds evidence of distinct commercial and research occupational subcultures within the CRCs, and informants report the subcultural boundaries to be highly visible, salient and only somewhat permeable. Boundary constructs include post-graduate qualifications, occupational proclivities towards exploration or exploitation activities, and motivations towards moneymaking or knowledge production. Furthermore, occupation specific argumentation styles appear to act as a barrier to equal and constructive participation of research and commercial occupational subcultures in commercialisation.

The findings of this study extend and challenge some of the management practices recommended by extant innovation research. In particular, the finding that process management techniques functioned to ease the transition from exploration to exploitation activities during commercialisation in one CRC contradicts advice to isolate exploration activities from process management. Directions for future research include the investigation of temporal orientations in research and commercial occupational subcultures in the context of commercialisation in hybrid industry-research organisations. Temporal attributes encompass planning horizons, mono and polychronicity, and attitudes towards pace and punctuality. Additionally, the findings regarding the impact of argumentation styles upon commercialisation justify further research to examine different national settings, industry sectors and occupational communities.
Chapter 1

Introduction

1.1 Background to the Study

Most studies concerning organisational culture and theories of innovation use an integrationist perspective (Berkhout, Hartmann, van der Duin, & Ortt, 2006; Damanpour, 1991; J. Martin, 1992; Meyerson & Martin, 1987; Santoro & Gopalakrishnan, 2000; Wolfe, 1994), characterised by assumptions of a single, consistent organisational culture within an organisation. My work addresses a gap in the organisational innovation literature by exploring the perceived impact of occupational subcultures on innovation in hybrid industry-research organisations. Investigating the viewpoints and experiences of researchers, engineers and managers directly engaged in commercialisation provides the opportunity to contribute to organisational cultural knowledge and innovation theory.

1.1.1 The Organisational Context of the Research

It is widely accepted that successful innovation can produce economic benefits for individuals, organisations, and nations resulting in competitive advantages (Australian Government Science and Innovation Mapping Taskforce, 2003; Gibbons et al., 1994; Lehrer & Asakawa, 2004; Porter, 2004; Senker, 1996; Sharif, 2006; Wolfe, 1994). Australians have a demonstrated ability to produce successful innovations. Examples include microsurgery, the black box flight recorder and the world’s first nanomachine. In common with many developed countries (D. O. Gray, Lindblad, & Rudolph, 2001; Handy, 1990; Irwin, More, & McGrath, 1998; Lehrer & Asakawa, 2004; Steiner, 2000) Australia is pursuing innovation as a source of national competitive advantage. However, good ideas and great science do not necessarily result in successful products (P. Roberts, 2004).
As a result, governments have made public research funding policy interventions intended to increase the rate and success of national innovation and, in some cases, produce a return on public monies invested in research institutions. Australia’s national system of innovation is being implemented through the Backing Australia’s Ability (BAA) funding package (Department of Education Science and Training, 2004a). The Cooperative Research Centre (CRC) program, which commenced in 1990, is one element of Australia’s BAA policy (Department of Education Science and Training, 2005). Australian CRCs are composed of industry, academic and government personnel, with government funding provided for a seven-year period. Renewal for second seven-year term is subject to competitive appraisal against other bids for funds.

The problem addressed by this research is that while the successful market launch of an innovation is acknowledged to be so unlikely that such events are described as “statistical outliers” (Matthews & Frater, 2003), little attention has been paid to how occupational interactions influence commercialisation processes. The rapid growth in the number and spread of triple-helix organisations, composed of industry, government and research personnel (Etzkowitz & Leydesdorff, 2000), indicates a massive global investment in a novel organisational form. While these hybrid industry-research organisations have been analysed from economic and structural perspectives (D. O. Gray et al., 2001; Lehrer & Asakawa, 2004; Liyanage & Mitchell, 1993), the potential impacts of occupational membership upon the operation of temporary, hybrid organisations composed of industry and research personnel, appears relatively unexplored.

In Australia, 45% of all businesses launched in 2003 had ceased trading by 2006. Working with new technologies or in emerging industries adds to this risk of failure. Singh (2003) cites failure rates of over 60% in the first six years for these organisations. If starting a new company in a high technology or emerging field were not sufficiently daunting, the core business of CRCs is innovation. CRCs work on non-routine tasks under conditions of uncertainty, and typically run a number of commercialisation projects concurrently. It is sobering to consider the findings of Barnett and Freeman (2001); organisational mortality rates increase with the simultaneous introduction of multiple products. Finally, because CRCs are form of
organisational alliance, they face additional risks of dissolution (Barringer & Harrison, 2000). In the face of such odds, reports that ‘many of these alliances simply do not work’ (Cyert & Goodman, 1997, p. 45) are not surprising. Therefore, investigating the potential influence of occupational subculture on the outcomes of hybrid industry-research organisations is clearly a worthwhile research topic.

1.1.2 National Systems of Innovation and Occupational Culture

Sporadic attention to the challenges occupational culture presents to commercialisation efforts has accompanied the rise of national systems of innovation and governmental interest in obtaining revenue and competitive advantage from research programs. For instance, in 1993, while discussing how US technology transfer legislation encouraged people to engage in practices that would have been improper or illegal not long ago, Berger commented:

Caution is the conditioned, or acculturated reflex of government officials and technologists asked to take actions to benefit industry. Industry, of course, has the mirror-image of that reflex. Both reflexes will change as the cultures change. We cannot expect individuals to risk getting too far ahead of their cultures (Berger, 1993, p. 36).

Schein links cultural change with successful experiences and time, stating cultural change is possible, but ‘Only shared experiences of success in using a new way of thinking or perceiving or valuing create a new approach, and that takes time’ (Schein, 1995, p. 12). Exploring the experiences and opinions of CRC participants fifteen years after the start of the CRC program provides an opportunity to explore the impact of the program upon perceptions of occupational cultural boundaries. Through interviews conducted in 2005, this research addresses the role played by inter-occupational interactions in the commercialisation stage of innovation, considers if cultural differences between research and commercial occupations are evident and if they influence commercialisation outcomes.

Organisational aspects of commercialisation have been extensively studied through structural foci, such as the size, funding and age of the organisation, using both qualitative and quantitative methods. Recent work (Riedlinger, Gallois, McKay, & Pittam, 2004; Siegel, Waldman, Atwater, & Link, 2004), although not designed with
the intention of considering the impact of culture upon commercialisation, suggests the norms and values of occupational subcultures may affect commercialisation processes and outcomes.

1.1.3 Discovery of Problem

‘Human life is reduced to real suffering, to hell, only when two ages, two cultures and religions overlap.’ (Hesse, 1963, p. 28)

Strong occupational cultures, working closely together under perceived pressure to perform, while not producing conditions that truly deserve to be called “hellish” may nonetheless create obstacles to success. Differences in communication styles, jargon, and motivations towards profit making may have the potential to accelerate, hinder or even prevent successful commercialisation.

The researcher’s interest in occupational subcultures arose from reports of conflict in a “hybrid” organisation, composed of members of the military and information technology (IT) graduates (C. S. Hayes, 2003). Acceptance of high power distance and a desire for uncertainty avoidance (Hofstede, 1993) seemed to have explanatory power for military behaviours of promptly following all commands from superior officers. In contrast, IT graduates would not respond to military symbols such as uniform insignia with immediate obedience, instead demanding they be governed by consent (Handy, 1990). This apparent example of cultural discord, coupled with eighteen years IT industry experience observing how the quality of human interactions often determined the outcome of technology-based projects, led to the desire to study occupational groups engaged in innovation.

Anecdotal evidence from an ex-member of a company which had graduated from the CRC program, combined with the survey results from the 2003 CRC Program evaluation report (Department of Education Science and Training & Howard Partners, 2003) suggest issues impacting collaboration exist and may be related to the existence and operation of occupational subcultures. A cursory inspection of members of research and commercial occupational subcultures could result in observations that they have much in common, and in predictions of unproblematic collaboration. Two groups of university qualified, office dwelling and primarily male
knowledge workers appear outwardly similar. However, common territory and a similar demographic background does not constitute sufficient evidence of a united occupational community (Van Maanen & Barley, 1984).

Organisational cultural theories do not appear to have been extensively applied to either CRCs or hybrid organisations engaged in commercialisation activities. While Turpin and his colleagues (Garrett-Jones, Turpin, Burns, & Diment, 2005; Turpin, 1999; Turpin & Deville, 1995; Turpin, Garrett-Jones, & Rankin, 1996) have produced important work on the CRC context, these studies have primarily drawn upon the perspective of researchers in government funded institutions. The experiences of commercial members of CRCs appear relatively neglected.

1.2 Justification and Worthiness of Proposed Research

Australia’s ability to develop knowledge into new, high-growth industries and solutions to social and environmental problems appears vital to the future of the country and maintenance of current standards of living. The Australian Federal Government is investing $5.3 Billion from 2005 to 2011 in science and training programs (Department of Education Science and Training, 2004). The CRC Program component of this investment is funded at approximately $220 million each year, and a total of $925.9 million is being provided for administered grants between 2006–07 and 2010–11 (Department of Education Science and Training, 2004b). A financial return is expected from publicly funded CRC research. The 2004 Federal Budget declined to continue funding the CRCs working on “public good” projects and the conclusions of the 2003 evaluation of the CRC program included stronger emphasis on “managing towards outcomes and a focus on new business development” (Department of Education Science and Training & Howard Partners, 2003).

Studying inter-occupational interactions in CRCs provides an opportunity to contribute to organisational cultural theory in the context of commercialisation. Furthermore, practical applications may improve the return on the investment of public monies in CRCs, and aid the development of new industries and new wealth
for Australians. Beyond the specific context of CRCs, knowledge concerning interactions between people with disparate backgrounds and occupational subcultures may have potential to improve productivity in other organisations.

1.2.1 Government Evaluations: Culture and the CRC Program

In the Australian context, government-funding inducements have been necessary to encourage members of research institutions and commercial companies to work together. Private R&D spending is proportionately lower in Australia than in other countries (Australian Government Science and Innovation Mapping Taskforce, 2003; Barlow, 2006). Moreover, research and business communities have, traditionally, had few points of interaction (Australian Research Council (ARC), 2001). The attractions of research networks or hybrid organisations as part of the innovation strategies of private sector companies include access to specialised expertise (Chesbrough, Vanhaverbeke, & West, 2006), combined with reduced risk and investment through sharing research and development costs (Quinn, 1985). From my perspective, the process of commercialising a new idea or product provides the opportunity to examine intense, extended interactions between commercial and research occupations.

The ’95 Myer Report, reviewing the achievements of the CRC program after five years of its existence, declared that synergy was now possible between business and research groups and that research culture was no longer a barrier to commercialisation (CRC Program Evaluation Steering Committee, 1995). The title of the report “CRC: Changing Research Culture” clearly communicated the government’s view that researchers needed to change. The report announced the completion of a transformation of research organisations and research culture, with increases in inter-university collaboration and contact with businesses cited as proof of cultural change, as the main achievement of the CRC program.

The Howard Partners 2003 review of CRC program did not dwell on cultural matters. Instead, it focussed on the structure of management boards and recommendations to form CRCs as incorporated companies rather than joint ventures.
in order to clarify roles and responsibilities in the commercialisation and new business development. Detailed recommendations appeared in two categories: program efficiency, effectiveness and flexibility; and the role of the CRC program within Australia’s science and innovation system. Discussion of occupational difference and its potential to influence commercialisation outcomes did not occur.

1.3 Research Aims

The material presented in sections 1.1 to 1.2 of this chapter leads to the thesis problem; that occupational subcultures may exist within CRCs and may influence commercialisation outcomes. The problem statement is that potential exists for occupational subcultures to exist within CRCs and to impact on commercialisation outcomes. This research operationalises organisational theories of culture and occupational subcultures, and illustrates them with cases of CRCs composed of commercial and research personnel engaged in commercialisation processes. Specifically, this study explores interactions between researchers, engineers and managers working together on commercialisation activities within CRCs in order to investigate the potential existence, and impact, of occupational subcultures upon the commercialisation phase of innovation. The research questions concern if and how occupational subcultures affect commercialisation processes and if the formation of occupational subcultures has managerial implications for reaching organisational goals.

The following research questions, expounded in Chapter 4, operationalise and explore the thesis problem:

1. Do members of CRCs engaged in commercialisation recognise subcultures in their organisations and if so, how do they describe and identify the subcultures?

2. What can be determined about boundaries between subcultures in terms of shape, thickness and permeability in the context of commercialisation practices and outcomes?
3. How do CRC members perceive that occupational subcultures impact upon their work?

4. How can occupational boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?

1.4 Overview of Methodology

The research questions are investigated using case research as a comprehensive strategy (Jones & Lyons, 2004; Stake, 2000) to explore contact between members of research and business occupations in two CRCs from the Information and Communications Technology sector and two from the Biomedical industry sector. Two of the organisations are currently receiving funding from the CRC program and the other two have graduated from the CRC program. The maturity of the organisations ranged from newly formed (two years of operation) to publicly listed companies with over fourteen years of operation. While the publicly listed company developed from a CRC had fewer organisational links than most CRCs, it was included to explore retrospectively the development of relations between occupations over time. Figure 5.1 on page 78 in Chapter 5 provides a schematic representation of the research design.

The CRC organisations involved in the study consist of individuals from a variety of professions aligned with a particular industry, located within a broad context of Australian society and public research policy decisions. The ability to effectively identify, isolate and accurately measure both dependent and independent variables within a natural setting is limited. In addition, the scant literature on occupational cultures within industry-academic research partnerships does not support attempts to define dependent and independent variables. Commercialisation processes are social activities, occurring in a complex social system within organisational and national cultures, and suit holistic investigation using qualitative methods. During this investigation, mainly emic insights, (referring to “insider” knowledge that is meaningful to members of a particular culture or subculture) were sought by
interviewing managers, engineers and researchers about their experience of occupational subcultures in commercialisation.

Twenty individuals from managerial, research and engineering roles were interviewed. Of these, seventeen came from the four CRCs recruited for the research. A single retrospective interview occurred with informants from the two graduate CRCs, and three longitudinal interviews were conducted with each informant from the currently funded CRCs. A total of thirty-six semi-structured interviews were conducted.

The interviewees’ experiences and perceptions of differing subcultural norms were recorded and transcribed verbatim. QSR N-Vivo® software was used to aid detailed coding and analysis of the collected research material, facilitating the interpretation process.

Through the analytic phase of the project, I found the research material clustered around a number of core themes. At least three main areas of subcultural divergence arose from interview analyses combined with reflection on the themes and comparisons between individuals and organisations. The major themes documented in this thesis are: the role of postgraduate qualifications in identifying members of commercial and research occupational subcultures; occupational patterns of motivation toward exploratory activities and rewards in the form of prestige and recognition or exploitative activities with monetary rewards; and occupation specific styles of debate including differences in the acceptability of dissent.

Parts of this research have been published as conference papers (Hayes & Fitzgerald, 2005; Hayes & Fitzgerald, 2006) and will appear (Hayes & Fitzgerald, 2007) as a journal article for an audience of organisational management scholars, CRC member organisations and individuals, and interested others. Appendices 1, 2, and 3 contain copies of these publications.
1.5 Outline of the Thesis

The thesis is comprised of nine chapters. Following the introductory chapter, Chapter 2 considers the literature associated with innovation and organisational culture. Anecdotal reports of occupational cultural dissonance in CRCs initiated the research and the organisational context of hybrid industry-research organisations exerts a strong influence upon the research. However, the research questions draw heavily upon innovation policy and organisational cultural concepts, so innovation and organisational cultural theories are first reviewed in Chapter 2.

Chapter 3 then provides examples of occupational subcultures, and examines research and managerial cultures in detail. The thesis also incorporates national innovation policy, as the unusual organisational context is largely an outcome of Australia’s national innovation policy. Chapter 4 incorporates the organisational context of the research by detailing the rise and impact of hybrid industry–research organisations and summarising innovation research that acknowledges occupational cultural concepts.

As shown schematically in Figure 1.1, the literature review chapters position the research problem in the context of extant organisational cultural, innovation and hybrid organisation knowledge.

Figure 1.1: Relationships between Occupational Culture, Innovation and Hybrid Organisation Literatures and the Thesis Problem Area.
Description and justification of the research method selected to explore the thesis proposition follows in Chapter 5. Findings concerning the first three research questions are contained in Chapter 6, while Chapter 7 examines the role of occupation-specific argumentation in commercialisation in depth. Chapter 8 continues to report the findings of the research, specifically the methods used to manage occupational boundaries in the four organisations explored. Finally, Chapter 9, Implications and Recommendations, summarises the thesis findings, and in describing the implications for policy and practice, addresses the fourth research question. The last chapter also acknowledges limitations of the study and identifies avenues for future research.

1.6 Choice of Organisational Cultural Framework for the Study

Attempts to understand organisations have been made using a plethora of approaches, helpfully categorised into four “frames” by Bolman and Deal (1997). The hybrid organisational context of CRCs could probably be productively analysed by any of the four frames: structural, human resources, political and symbolic. For example, a structural frame could consider the commitment of researchers funded by a CRC to work on a part-time basis, and who may view their loyalties as belonging to their “home” research organisation, which holds their employment contract and career opportunities. Similarly, a political frame may be applied to external, government funding decisions as well as to the potential for internal issues of rivalry and power between the member organisations of each CRC. However, as justified in Chapter 2 and summarised below, this thesis focuses upon the symbolic, cultural influences that affect the outcomes of Australian hybrid research centres.

An organisational cultural framework was chosen as the “lens” to examine interactions in organisations engaged in commercialisation, a choice that is justified in full in Chapter 2. The two main reasons advocating for the use of an organisational cultural frame are summarised here. First, the flexibility provided by the organisational cultural frame supports its use as the framework for an initial, exploratory investigation. Second, and from a practical perspective, the notion of
organisational culture was likely to be familiar to research participants as an extension of concepts of national culture and from their own organisational experiences. I believe the familiarity of the concept of culture aided participant recruitment and communication of the study’s aims.

However, other symbolic choices were considered. Two viable alternatives are Discourse Analysis and theories of voluntary inter-firm cooperation. Discourse Analysis challenges the notion that stability and shared patterns are the norm in organisations and views power as dynamic and relational (Grant & Iedema, 2005). In particular, discourse analysis claims that cultural investigations fail to recognise the complexity of organisational life. This is a valid criticism of the popular integrationist perspective of organisational culture, but not of concomitant organisational cultural frames, such as the differentiation and fragmentation views (Fitzgerald, 2002; J. Martin, 1992, 2002; Meyerson & Martin, 1987). In addition, recent work examining Australian industry/academic partnerships using relationship marketing theory (Plewa & Quester, 2005, 2006) has comprehensively considered aspects of voluntary inter-firm cooperation such as trust and commitment (Parkhe, 1993).

1.7 Definitions of Key Terms

Throughout this thesis, I refer to ‘hybrid industry-research organisations”. Other authors have used terms such as “Industry-University research centres” (D. O. Gray et al., 2001; Tornatzky, Lovelace, Gray, Walters, & Geisler, 1999), “University-Industry research partnerships” (G. Harman, 2001), and “University-Industry relationships or linkages” (Plewa & Quester, 2005, 2006) to describe collaborative work between practitioners and academicians that spans organisational boundaries. The term hybrid industry-research organisation accurately reflects the disparate organisational locations inhabited by the study’s research informants. Of the ten researchers interviewed, three worked at universities, three worked in other research institutions such as government-funded laboratories, two worked for the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO), one worked in a publicly listed company and one in a private company. Consequently,
the term hybrid industry-research organisation describes the diversity of research
groups active in CRCs.

Scholars of organisational culture define jargon as special words that cultural
members understand but that can make communication difficult for outsiders to
interpret (Trice, 1993). Not surprisingly, the organisational cultural studies
community has its own set of jargon, special terms used as a type of shorthand to
signify important concepts. Definitions and examples of the less common
organisational cultural jargon used in this thesis appear in the table below,
accompanied by examples.

Table 1.1: Definitions of Organisational Cultural Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Themes</td>
<td>Common threads of meaning that can be detected in cultural symbols or manifestations. These themes may be cognitive, based on beliefs or tacit assumptions, or attitudinal, dealing with the values held by members of a culture. Furthermore, (J. Martin, 2002), divides content themes into overt, espoused themes, which are used to make a desirable impression upon an audience, and covert, inferred themes, which reflect a deeper level of interpretation. For example, an organisation may display an espoused commitment to work life balance, with policies and procedures that support the personal needs of employees to care for young or elderly family members. At the same time, there may be a contradictory inferred theme, in which time spent in the office is interpreted as a sign of dedication, and cultural insiders interpret any reduction of “face hours” in the office as a sign of inadequate organisational commitment.</td>
</tr>
<tr>
<td>Countercultures</td>
<td>Countercultures reject organisational values, and are in open conflict with the parent organisation.</td>
</tr>
<tr>
<td>Jargon</td>
<td>Special terms or words, sometimes constructed from acronyms. Over time a unique language can develop that helps members identify other members of the culture, and exclude outsiders (Greenberg &amp; Baron, 1999). Professions and organisations working in high-technology fields are noted for their use of jargon as a means to increase the speed of communication between members, and restrict the participation of people who are not full members (Kunda, 1992). The use of jargon is by no means restricted to high-technology professions. Around the world McDonalds’ employees use “McSpeech” referring to hamburgers as “sandwiches” and alerting counter staff to the arrival of the next batch of Big Macs with the cry “Macs up!”</td>
</tr>
<tr>
<td>Norms</td>
<td>Generally agreed upon, informal rules that guide the behaviour of organisational members. They are not written down, and may be</td>
</tr>
</tbody>
</table>
### Term | Definition and Description
---|---
Prescriptive | Specifies actions that should be performed, or proscriptive, dictating behaviours to be avoided (Greenberg & Baron, 1999). Members of an organisation know the norms for swearing (including what can be said and where), and how long is really available for lunch. New members of the organisation learn these norms informally from the existing members.

**Organisational Stories** | Often repeated, and sometimes embellished stories of the activities of members, particularly founders or high status individuals. These stories are retold in order to illustrate how things “should” be done in the organisation or to show how the organisation differs from its competitors (Wood, Wallace, & Zeffane, 2004). Examples of organisational stories include the founder of Nike, Phil Knight starting his business by selling shoes from the boot of his car during athletic events and T.J. Watson, the founder of IBM, hiring sales people during the 1920s depression.

**Rituals** | Standardised and recurring activities used by workers to reduce anxiety and promote ethnocentrism (Trice, 1993).

**Rites and Ceremonies** | Elaborate, dramatic and planned public activities that consolidate several cultural forms into one event to deliver meaning (Trice & Beyer, 1984). One example is annual fire safety training; incorporating several elements such as a welcome speech, extinguishing a small fire and a roundtable discussion of safety issues encountered by members in the previous twelve months.

**Subcultures** | Subcultures are defined as unique patterns of values and philosophies that are shared by a group, and that differ from, but are compatible with the dominant culture of the organisation (Trice, 1993). For instance, Kunda (1992) identifies separate subcultures within a high-technology organisation based upon possession of permanent or temporary employment status.

---

### 1.8 Delimitations of Scope and Key Assumptions

A number of explicit and implicit boundaries apply to the methodology of this research. As described in sections 1.3 and 1.4 of this chapter, this research explores the existence, characteristics and influence of occupational subcultures in four Australian CRCs. Although the issues documented and analysed in this thesis may be
identifiable by the larger cohort of researchers and managers working in hybrid industry-research organisations in other countries, this research is limited to the Australian CRC program. The IT Current, IT Graduate, Biomedical Current and Biomedical Graduate CRCs may not be typical of all Australian CRCs and the Australian CRC program may not be representative of triple helix organisations elsewhere, particularly in terms of the strength of researcher and managerial occupational subcultures. However, this organisational cultural study of the commercialisation stage of innovation can be compared to national systems of innovation around the world.

Inevitably my demographic characteristics and educational, occupational and life experiences influenced the filters I applied in interviews and the frames I used in their analysis. In reciprocal fashion, my personal attributes such as being a 45-year-old female, parent and migrant of an Anglo background will have influenced the way participants perceived me, and will have influenced what was discussed and what was withheld during interviews.

Tension exists between the values I absorbed during my extensive and extended exposure to scientific method and statistics in my Bachelor of Science studies and the commercial and managerial norms absorbed in eighteen years working in Information Technology (IT). The attraction towards researching an intellectually intriguing problem (as I have in this thesis) was easy to understand and empathise with when talking to researchers. Conversely, the drive to meet deadlines displayed by members of commercial occupations also resonated with me as a result of spending thirteen years in management positions pursuing annual performance targets. Therefore, my personal experience of both academic and business contexts may have assisted my understanding of the hybrid research context.

My personal, educational and managerial experiences will have influenced my interpretation of the data. However, critical self-reflection immediately after the interviews, while typing the transcripts and during analysis assisted in identifying and balancing the impact of researcher bias. Insights from my work experience led to greater variety and more balance in the inductive insights incorporated into the reflexive journal, and consequently contributed to the trustworthiness of the work
(Lincoln & Guba, 1985). Details of the period during which interviews occurred for each organisation are contained in Appendix 4.

The research findings, as is the case with all qualitative work, are constrained by time, place, and the changeable nature of individual perspectives. Extrapolation of the findings to other contexts may not be appropriate. However, the insights provided by the interviewees have potential to extend existing theory to consider the impact of occupational subcultures on the functioning of hybrid research centres.

This chapter provides the foundation for the thesis, by introducing the research context, issues and problem. The research is justified, definitions presented, and the rationale of using qualitative research and an organisational cultural frame briefly described. The chapter expounds the research aim: exploring the potential influence of occupational subcultures within hybrid industry-research organisations engaged in commercialisation. In addition, the thesis structure is outlined and its limitations acknowledged. Based upon these foundations, the thesis proceeds with a detailed description of the theoretical foundation for the research, in the form of three literature review chapters.

The thesis’ findings show that one challenge of working in hybrid organisations is that of operating within an organisational cultural paradox; the beliefs, values and assumptions held by groups within the organisation are seemingly contradictory and yet valid. The thesis proposition is that occupational subcultures exist within Australian Cooperative Research Centres and impact on commercialisation outcomes.
Chapter 2

Literature Review
Innovation and Organisational Culture

2.1 Introduction

The literature review spans the next three chapters and provides a theoretical base from which to explore occupational subcultures in innovation. As illustrated in Figure 1.1, page 10, it synthesises findings at the intersection of three domains of knowledge: innovation, organisational culture, and hybrid industry-research organisations.

This literature review chapter starts by reviewing the concept of innovation and national systems of innovation literature. These topics are pertinent as commercialisation is a subset of innovation and national systems of innovation policies have provided much of the impetus for developing close working relationships between researchers and research users. Historically, Australian research and business communities have operated independently with few points of contact. However, starting in the 1980s, and accelerating through the 1990s the two groups have worked together in applied research aimed at creating economic value (Australian Research Council (ARC), 2001; Plewa & Quester, 2006).

Following the critical review of innovation literature, the chapter continues to review theories of organisational culture and develop the definition of organisational culture used to research the thesis proposition: that occupational subcultures exist in hybrid industry-research organisations and impact commercialisation outcomes. The value of a three-perspective view of organisational culture in decoding dynamic and
complex organisational contexts is described in preparation for application to hybrid organisations engaged in commercialisation.

Finally, a combination of theories pertaining to organisational culture and innovation theory introduces the topic of occupational subcultures engaged in innovation activities, which continues into Chapter 3. Then, Chapter 4 contains a synthesis of innovation, organisational cultural and occupational subcultural research applied to the literature regarding the hybrid industry-research organisation context.

2.2 Definition of Innovation

There are many definitions of innovation, with no consensus on what constitutes a good working definition (Johannessen, Olsen, & Lumpkin, 2001). Most link the discovery or creation of something new to its practical application. The definition adopted in this work follows in Figure 2.1:

![Figure 2.1: Definition of Innovation]

This definition makes clear the dual requirements for creation and application of knowledge in innovation, regardless of whether the innovation relates to processes or products, or where it lies on the continuum from incremental to radical innovation. Also, the definition is in use in Australian innovation policy and so has the advantage of being consistent with the environment in which CRCs operate.

However, the boundaries between the creation and application of knowledge are not sharply defined. The following figure provides a useful representation of the overlap between “pure” scientific knowledge generated primarily through research communities and applied technological knowledge. While some activities can be categorised as either science or innovation, a large area of overlap exists. As will be
expounded in Chapter 3, while members of research and commercial occupational cultures may share the same physical territory, they regard themselves as different and separate.

Figure 2.2: Overlapping Research and Innovation Activities

Commercialisation is an element of the innovation process. As shown in Figure 2.2, commercialisation bridges basic and applied spheres of research activity, spanning the creation and technological application of knowledge. As Kassicieh and Radosевич (1993, p. 127) explain:

Technology is applied knowledge imbedded in tools, equipment and facilities, in work methods, practices and processes, and in the design of products and services. It is "know-how" in contrast to the "know-why" that characterises science. ... In terms of traditional stages of innovation, science is most closely related to pure, fundamental or basic research, while technology is most closely associated with applied development and engineering.

Commercialisation is defined as ‘the process of transforming ideas, knowledge and inventions into greater wealth for individuals, businesses and/or society at large’ (Prime Minister's Science Engineering and Innovation Council, 2001, p. 9). It is this phase, in which participants seek a financial return on research, which forms the focus of activities in CRCs and of this study. To assist in understanding the context
in which the occupational subcultures discussed in the Chapter 3 operate, a short review of innovation literature follows.

2.3 Overview of Organisational Innovation Literature

‘The most consistent theme found in the organisational innovation literature is that its research results have been inconsistent’ (Wolfe, 1994, p. 405).

Attempting to make sense of the inconclusive and inconsistent findings that characterised studies of innovation, Wolfe (1994) organised prior research into three research streams: Diffusion of Innovation, Organisational Innovativeness and Process Theories. Diffusion of Innovation research tracks the adoption and spread of innovations within and across organisations and markets and Organisational Innovativeness investigates the determinants of an organisation’s propensity to innovate. Process Theories, concerning how and why innovations emerge, develop and grow, have greater applicability to this research than Diffusion of Innovation or Organisational Innovativeness research, and will be applied in the discussion and conclusion chapters of the thesis.

It should be noted that Process Theories of innovation, beginning with simple models (Daft, 1978), have evolved through five “generations”, adding feedback loops between stages and increasingly integrating external stakeholders, such as customers and suppliers (Chesbrough et al., 2006; Miller & Morris, 1999; Rogers, 1996; Science and Innovation Mapping Taskforce, 2003). The most recent 5th generation or “open” process models have direct applicability to the management of commercialisation in a hybrid or network organisation, where a variety of stakeholders collaborate in the production of a product or service.

In addition to identifying the three streams of innovation research, Wolfe (1994) emphasised the importance of specifying the personal, organisational, technological and environmental contexts in which innovation occurs in order to make meaningful comparisons. This use of multiple factors beyond organisational structure had been
used previously (Quinn, 1985) and continues to garner support (Taylor & McAdam, 2004).

Nevertheless, up until the current time, easy to measure, structural characteristics of organisations, such as age and size have provided the basis of most studies of innovation (Wolfe, 1994). However, meta-analyses of innovation literature (Damanpour, 1991) taking into account the type of innovation, stage of the innovation process, size of organisation and other variables failed to reveal a consistent pattern, leading Fiol (1996) to propose an alternative explanation for the inconsistency of research results. She theorised that organisational innovation research is best viewed as two distinct categories of exploration and exploitation studies, drawing an analogy to exploration and exploitation activities in organisational learning (March, 1991). Exploration concerns the ability of organisations to identify, assimilate, combine and share knowledge. Fiol (1996) compares this to the absorptive capacity of a sponge, adopting the ‘absorptive capacity’ terminology introduced by Cohen and Levinthal (1990) when they proposed that internal R&D serves two purposes: to generate innovations and to provide the ability to absorb relevant knowledge appearing in the external environment.

The second group of studies focuses on exploitation, or the effective application of innovative knowledge through commercialisation into products and services. Organisational factors determining the efficiency and effectiveness of launching innovations into external markets, or implementing them internally, provide the complementary action in the sponge analogy; that of squeezing out absorbed and reconfigured knowledge in a new and more valuable form. Fiol’s recognition of the split in innovation studies between knowledge inputs and commercialisation outputs may offer new insight into conflicting innovation research results.

Additionally, Fiol’s (1996) model of two spheres of innovation activity reveals an underlying difference in the approaches of academic disciplines to the study of innovation. Although she does not identify it, the studies of “absorptive capacity” originate from scholars located in schools of business or management. Twenty-one of the twenty-two authors of the studies grouped into “knowledge absorption” work
in schools of management or business. In Fiol’s publication (1996), it is only in the
application and exploitation of knowledge that researchers from engineering,
accounting, information systems and law appear, with just thirteen of the twenty-one
authors of “knowledge application” works originating from management and
business schools. This may reflect disciplinary differences in the assumptions,
methods and interests of innovation scholars.

2.4 National Systems of Innovation

Articles concerning innovation follow a predictable pattern in starting by extolling
the economic benefits and competitive advantage available to individuals,
organisations, and nations who are successful innovators (Australian Research
Council (ARC), 2001; Etzkowitz & Leydesdorff, 2000; Faems, Van Looy, &
Debackere, 2005; Gibbons et al., 1994; Lehrer & Asakawa, 2004; Logar, Ponzurick,
Spears, & France, 2001; Nowotny, Scott, & Gibbons, 2001; Science and Innovation
Mapping Taskforce, 2003). The Organisation for Economic Co-operation and
Development is invoked as having substantiated the link between a nation’s
researchers and its ability to innovate:

According to the Organisation for Economic Co-operation and Development (OECD),
all technological innovations can be traced back, at least in part, to science and
engineering. In some areas, such as biotechnology, information and communications
technology (ICT), medicine and new materials, scientific progress is particularly
important in driving innovation (Science and Innovation Mapping Taskforce, 2003, p. 2,
emphasis added).

The attractions of economic benefit and competitive transformation have given rise
to national systems of innovation, in which governments seek to influence the rate
and course of innovation through managing the relationships between industry,
universities and government research institutes in a systematic manner.

In common with many developed and developing economies (Barlow, 2006; D. O.
Gray et al., 2001; Handy, 1990; Irwin et al., 1998; Kassicieh & Radosevich, 1993;
Lehrer & Asakawa, 2004; Steiner, 2000) Australia is pursuing innovation as a source
of national competitive advantage. Changing the criteria for access to public research
funding to include a commercial partner is intended to increase the rate and success
of national innovation and produce a return on public monies invested in research institutions. However, good ideas and great science do not necessarily result in successful products (Roberts, 2004) and there are some dissenting voices. For example Quirk (2005, p. 36), offers the following comment:

A body of evidence shows that the policymakers' view of how innovations come about is seriously wrong. Innovation is not the smooth progression of an idea from a university research laboratory through 'commercialisation' to a successful business. The interaction of governments, academic, business and the commercial markets has a random pattern of success and failure.

Instead, he proposes that the migration of entrepreneurial, boundary-crossing individuals out of research roles and into business is the true source of innovation.

Notwithstanding such protests, the Australian Federal Government is investing approximately A$220 million each year in the CRC program (Department of Education Science and Training, 2006). Pressure is being exerted upon publicly funded researchers to produce financial rewards as evidenced by the 2004 Federal Budget declining to continue funding for CRCs working on public good projects. In addition, the conclusions of the 2003 evaluation of the CRC program included stronger emphasis on, ‘managing towards outcomes and a focus on new business development’ (Department of Education Science and Training & Howard Partners, 2003, p. 108). Australia’s national system of innovation policy clearly intends to produce some financial return from the CRC program.

2.5 Definition of Organisational Culture

While culture is an abstract concept, most people are familiar with the notion of national culture, and could contrast Australian culture with Japanese culture without needing a definition of culture to complete the task. In 1957 Goodenough (cited in D'Andrade, 2001, p. 243) provided an early and practical definition of societal culture as, ‘Whatever it is one has to know or believe in order to operate in a manner acceptable to its members’.

Descriptions of visible or material aspects of culture are complemented by cultural abstractions, meanings and ideas. Such ideational concepts include deeply held,
taken-for-granted assumptions that determine feelings and behaviour, which most members of a culture do not question. These cognitive components of organisational culture are claimed to be more influential than visible forms (Schein, 1990; 1996). For instance, beliefs about the value of punctuality may be different in two organisations, leading the same observable act (e.g. arriving late), being variously interpreted as problematic, or of no concern. Consequently, it is important that any definition of organisational culture embrace abstract, cognitive elements in addition to physical signals of cultural membership.

The concept of organisational culture provides fertile ground for debate about its exact definition. Martin (2002) has provided a comprehensive review of the parameters that generate debate, which include whether a broad or narrow range of cultural manifestations should be included in any definition or study of culture (Meehan, 2001), and whether culture is based purely on ideas, solely upon material manifestations, or a mix of the two. The value of deep interpretation of physical manifestations to uncover unconscious assumptions contrasted with acceptance of the superficial meaning of cultural artefacts provides another key parameter for debate (J. Martin, 2002).

Differences of opinion also exist concerning the question of whether the culture shared by a group is simultaneously unique from every other culture. Claims that every organisation possesses a unique culture have provoked scepticism (J. Martin, 2002). However, the large number of McDonald’s restaurants spanning the globe provides a helpful example. Despite corporate insistence upon standardised processes and menus, I believe the influence of national cultures, the priorities of the franchise owner, and the demographic characteristics and personalities of the employees will combine to produce variations, some obvious and some subtle, in what is viewed as correct behaviour. Consequently, the claim for the uniqueness of each organisation’s culture is accepted, based on contextual factors that may change over time, such as the composition of the group. Hence, the key dimensions of organisational culture definitions include the range and type of manifestations considered, the depth of analysis employed, and the degree to which culture is considered to be shared and yet unique.
Having considered the key dimensions used to define organisational culture, the definition of culture used in this research is presented below. It accepts that organisational culture involves both ideas and physical expressions of those ideas such as belief systems and uniforms. Organisational culture represents shared and unique networks of meaning and is best understood through the in depth study of a broad range of manifestations.

My definition relies heavily upon Martin’s (2002) review of cultural definitions and D’Andrade’s (2001) representation of culture as a system rather than an entity. Multi-perspective views of organisational culture (Fitzgerald, 2002; Hofstede, 1998; J. Martin, 1992, 2002; Meyerson & Martin, 1987; Schein, 1990; Trice, 1993) have also influenced the definition adopted through their recognition that multiple cultures exist in an organisation at any given time.

**Figure 2.3: Definition of Culture**

| Organisational Culture is defined as the networks of shared meaning, sometimes attached to material manifestations that lead to the development of distinctive social systems and the characteristic linkages between the boundaries of such systems. |

The broadness and flexibility of organisational culture theory makes it a useful lens to apply to perceptions of commercialisation efforts in industry-research centres. An organisational cultural frame provides the opportunity for holistic exploration of the CRC context through the concepts perceived to be significant by CRC members. In contrast, the use of an approach with a unitary focus such as language, (e.g. Discourse Analysis), or inter-group comparisons (e.g. Social Identity Theory) while potentially applicable, may unnecessarily restrict the scope to explore and understand what happens inside a CRC, and lead to failure to identify important concepts.

In contrast to single focus theories of group behaviour, such as the emphasis placed on inter-group discrimination in Social Identity Theory, four types of cultural manifestations, or artefacts, are routinely used to interpret an organisation’s culture (Hofstede, 1993; E. Martin, 1998; J. Martin, 2002; Meehan, 2001; Meyerson &
Martin, 1987; Schein, 1990; Traweek, 1993; Trice, 1993; Trice & Beyer, 1984; Van Maanen & Barley, 1984). These cultural manifestations include cultural forms (such as organisational rituals, stories, jargon, humour and physical settings), formal practices (including pay schemes and reporting structures), informal practices (such as norms) and content themes. Definitions and examples of the less common organisational cultural terms appear in Table 1.1 on page 13 of the previous chapter. To summarise, organisational culture provides an approach capable of addressing the complexity of interactions within hybrid organisations and with sufficient flexibility to accommodate emergent findings.

2.6 The Functional View of Organisational Culture

Interest in the idea that organisations may possess a distinctive culture became apparent in the late 1970s. The publication of “In Search of Excellence: Lessons from America’s Best Run Companies” (Peters & Waterman, 1982) combined with management texts attributing Japan’s strong economic performance to the organisational culture of its corporations resulted in a view that controlling organisational culture should be a managerial competency.

The functional or managerial view assumes culture can be managed and has a causal relation to the performance of a company. The notion that managers can manipulate elements of an organisation’s culture to produce desired results epitomises the functional view of organisational culture. In their preface, Kilmann, Saxton and Serpa clearly assert that a causal link exists between organisational culture and organisational success:

The best way to make a company successful is to have a culture that influences all members to adopt, by tacit agreement, the most effective approach, attitude and behaviour on the job (Kilmann, Saxton, & Serpa, 1985, emphasis added, p. x).

Others (Deal & Kennedy, 1982; Kotter & Heskett, 1992; Stace & Dunphy, 1994), laud the economic value of strong organisational cultures and offer prescriptions for organisational culture renewal. Functional writings from the USA dominate the field
of organisational culture, written with a managerial conviction that culture can be built or modified to influence business results (J. Martin, 2002).

In contrast to the benefits attributed to the overt management of organisational culture, it has been proposed that efforts at normative control may prove to be self-defeating. Kunda (1992) described a high-technology organisation populated by cynical actors, skilled in presenting the expected behaviour, but with decidedly ambivalent feelings towards the organisation. Public displays of commitment and enthusiasm hid attitudes at odds with corporate interests. This occurred despite the constant inspection and reinforcement of the culturally endorsed behaviours advocated by the authors of strong culture management texts:

….agents of control are everywhere: one is surrounded and constantly observed by members (including oneself) who, in order to further their own interests act as spokespersons and enforcers of organisational ideology (Kunda, 1992, p. 155).

Furthermore, while the advantages proposed for “strong cultures” have attracted managerial interest, empirical assessments of the performance of the companies praised as the embodiments of strong culture have not supported a link between strong culture and strong financial results (J. Martin, 2002). Consequently, support for the benefits of strong organisational cultures is not unanimous. These findings have led to questions regarding the accuracy of the representation of organisational culture as a homogenous and malleable feature of an organisation’s internal environment.

In summary, the functional view of organisational culture, while widespread and influential with scholars and practitioners, does not have empirical, or unanimous support. My stance is one of qualified support for the functional view of organisational culture, developed over eighteen years spent working in an international, “strong culture” firm in the IT industry, including a year spent managing its reward and recognition program. This experience provided the opportunity to encounter, and at times create cultural artefacts that appeared to influence peoples’ behaviour in organisationally desired ways. However, based on that same experience, it is my view that simplistic, prescriptive cultural change programs, claiming to provide tools to manage an organisation towards any desired
destination, do not address the complexity and at times chaotic reality of organisations. The factors that determine whether members accept or reject attempts at normative control are numerous, and interact in complex ways. As will be discussed in the following section, this is consistent with a multi-perspective view of organisational culture. I believe organisational culture provides, at least, a vehicle for member cohesion. It may provide more at various times, and in various forms.

### 2.7 Three Perspectives of Organisational Culture

This thesis argues that assumptions of organisational homogeneity, leading to attempts to enforce one set of “strong” organisation-wide norms, can lead to tension between occupational subcultures and to reduced organisational performance. Multi-perspective views of organisational culture, which emphasise the distribution of patterns of similarities and differences in organisations (Fitzgerald, 2002; J. Martin, 1992, 2002; Meyerson & Martin, 1987), are central to this argument. Examination of the three perspectives view of organisational culture follows.

Champions of strong culture use an integration perspective (Meyerson & Martin, 1987), focusing on cultural manifestations that have consistent interpretations, and regarding culture as a clear consensus without ambiguity. This is the primary perspective of functionalist and managerial views of organisational culture (Deal & Kennedy, 1982; Kilmann et al., 1985; Kotter & Heskett, 1992; Stace & Dunphy, 1994).

The differentiation perspective focuses upon cultural manifestations that have inconsistent interpretations, for example; departments within an organisation may all publicly espouse one set of values, but behave very differently. The differentiation perspective considers consensus to exist only in subcultures. Subcultures may exist in harmony, independently or in conflict with each other and the parent organisation, but within a subculture there is clarity. In the differentiation view, ambiguity exists in the spaces between subcultures. Despite Martin’s (2002) assertion that integration and differentiation do not represent different levels of analysis, such as organisation
compared to group, some argue that differentiation is a form of integration, observed at a lower organisational level (Fitzgerald, 2002). However, like Martin, I believe that differentiation and integration perspectives represent fundamentally dissimilar views. The integration perspective posits that the totality of an organisation’s cultural assumptions will subsume evidence of occupational, gender or other diversity within the organisation. This is not consistent with my experience in the IT industry, nor the literature related to diverse organisational settings (Duke, 1995; Guzman & Stanton, 2004; Hakala & Ylijoki, 2001; Kunda, 1992; Trice, 1993; von Meier, 1999).

Balanced against the integration and differentiation perspectives, the fragmentation perspective claims relations between cultural manifestations are neither clearly consistent nor inconsistent and views ambiguity, not clarity, as the core of culture. Viewed through the frame of fragmentation, consensus is transient and issue specific (J. Martin, 2002).

Fitzgerald (2002) provides a valuable summary of a multi-perspective view of organisational culture theory by using three dimensions to compare integration, differentiation and fragmentation frames. These are orientation to consensus, orientation to ambiguity and the relationship between cultural manifestations, illustrated in Table 2.1.

Table 2.1: Summary of Three Perspectives

<table>
<thead>
<tr>
<th></th>
<th>Integration</th>
<th>Differentiation</th>
<th>Fragmentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation to consensus</td>
<td>Consensus across entire organisation</td>
<td>Subcultural consensus</td>
<td>Transient consensus</td>
</tr>
<tr>
<td>Relationships between cultural manifestations</td>
<td>Consistent</td>
<td>Inconsistent</td>
<td>Not reliably consistent or inconsistent</td>
</tr>
<tr>
<td>Orientation to ambiguity</td>
<td>Ambiguity is unacceptable</td>
<td>Ambiguity exists outside subcultures</td>
<td>Ambiguity is embraced</td>
</tr>
</tbody>
</table>

(Adapted from Fitzgerald, 2002, p. 33)
Whilst the three perspectives of integration, differentiation and fragmentation may seem to offer mutually exclusive views of an organisational culture, Martin (2002) clearly states that elements of integration, differentiation and fragmentation are all present in an organisation’s culture at any one time. One pattern may be dominant and more easily detected than others, but over time or due to environmental changes, the organisation’s culture will be dynamic; the currently dominant perspective will recede and other frames will become more visible. The potential existence of multiple cultures within one organisation and the idea of links between the boundaries of distinctive social systems are consistent with the definition of culture developed for and used in this research.

Most studies concerning organisational culture use a single organisational cultural perspective (J. Martin, 2002). The same is true of the majority of innovation research. Assumptions of a single, homogeneous organisational culture can obscure important information about organisational function (Hofstede, 1998). The use of three perspectives, integration, differentiation and fragmentation, may assist in identifying the functions performed by, and the outcome of interactions between occupational sub-groups within the larger organisation. This work addresses a gap in the organisational innovation literature by investigating the perceived impact of occupational subcultures upon innovation from the perspective of people directly engaged in commercialisation activities.

Knowledge of organisational culture and innovation are central to this thesis because of the context of the research (hybrid industry-research centres engaged in innovation activities) and the research questions’ concern with occupational subcultures. The chapter continues to describe the assumptions of organisational cultural homogeneity that underlie the majority of innovation studies. I assert that the composition of hybrid industry-research organisations requires viewing such organisations from more than one organisational cultural perspective and consideration of the potential for occupational subcultures to exist and influence the outcome of commercialisation efforts.
2.8 Innovation and Organisational Culture

A strong integrationist perspective of organisational culture is evident in the national systems of innovation literature. Comparisons across nations, economic communities and continents (Lehrer & Asakawa, 2004) presuppose organisational cultural homogeneity exists within these boundaries. Similarly, there is often little recognition or accommodation of the potential impacts of organisational or occupational subculture in research into organisational innovativeness. For example, Sorensen and Stuart (2000) use patent activity as the sole measure of innovation in their study of innovativeness and organisational age. When studies of innovation at the level of an individual firm do consider organisational culture, integrationist assumptions of consistent values and beliefs throughout the organisation are common (Jassawalla & Sashittal, 2002). For example, entire organisations are identified as exemplars of innovation culture, despite known subcultural differences amongst its members (J. Martin, 2002; Quinn, 1985).

Similarly, Process Theories of innovation display integrationist assumptions through their emphasis on “executive buy-in”. If the executive of the organisation is seen to support the innovation process, it is expected that all organisational members will act in accordance with his or her edict (Spanyi & Eibel-Spanyi, 2004). As an illustration: ‘The plan must be approved and supported by senior management, ensuring that there is alignment between all functions…’ (R. G. Cooper & Edgett, 1996, p. 32). Consequently, the use of other perspectives of organisational culture, such as differentiation or fragmentation, to consider innovation processes provides the opportunity to expand current knowledge and theory. A dominant perspective of organisational cultural differentiation, applied to the innovation performance of thirty-eight groups within a large US Government research and development agency demonstrates the potential suitability of this approach to studies of innovation (Hurley, 1995).

Innovation involves the practical application of new knowledge. This requires at least two types of occupational cultures; the pragmatic, systematic roles filled by a variety of commercial occupations, and the exploratory roles performed by “pure”
researchers. Commercialisation activities combine the discoveries of researchers, such as scientists, with the commercial skills of engineers and managers (Lam, 2005; Steiner, 2000). Therefore, bringing innovative ideas to emerging or established markets involves interactions across occupational cultures (Hayes & Fitzgerald, 2005); moreover, tension between occupational cultures may be implicit in innovation (Epton, Payne, & Pearson, 1983; Gibbons et al., 1994).

The dominance of single perspective, primarily integrationist studies may have resulted in a “blind spot” in relation to organisational culture and innovation outcomes. To date, a mono-cultural perspective of innovation in organisations may have neglected the possibility that other frames are dominant, particularly in hybrid organisations. The rapid and global increase in the use of hybrid industry-research organisations to support national innovation objectives gives impetus to review hybrid industry-research organisations from more than one perspective, and to consider the potential for occupational subcultures to exist within and influence the outcome of commercialisation efforts. Chapter 4 explores this possibility by examining the organisational context of hybrid industry-research organisations in general and Australian CRCs in particular.

Building on the review of theories of innovation and organisational culture relevant to CRCs and commercialisation, the following chapter concerns extant research regarding occupational subcultures and sub-cultural boundaries. Managerial and research cultures are examined in detail to understand the characteristics of occupational subcultures potentially involved in commercialisation activities. Chapter 4 considers the organisational context of the research. This includes investigation of the hybrid industry-research organisation, and provides summaries of the methods and findings of previous studies of hybrid organisations invoking organisational cultural theory. Finally, existing research concerning Australian CRCs is presented, leading to the thesis research questions.
Chapter 3

Occupational Subcultures in Innovation

3.1 Introduction

As detailed in chapter two, most studies concerning organisational culture use an integrationist, mono-cultural perspective. The same is true of the majority of innovation research: for examples see Duke (1995), Bruce, Leverick and Littler (1995) and Lam (2005). The work presented here addresses a gap in the organisational innovation literature by investigating the impact of occupational subcultures upon innovation from the perspective of people directly engaged in commercialisation. First, evidence for the existence of occupational subcultures within organisations is presented. Next, literature concerning managerial and research subcultures is summarised. Finally, external similarities and potential cognitive differences between managerial and research subcultures are considered.

To restate, the organisational cultural perspectives of integration, differentiation and fragmentation are not mutually exclusive. Elements of integration, differentiation and fragmentation are all present in an organisation’s culture at any one time (J. Martin, 2002). One pattern may be dominant and more easily detected than the other two, but over time or due to environmental changes, the organisation’s culture will be dynamic; the currently dominant perspective will recede and other frames will become more visible.

Since innovation involves the practical application of new knowledge, it is likely to involve at least two broad categories of occupational cultures; the pragmatic, systematic roles filled by a variety of commercial occupations, and the exploratory
roles performed by “pure” researchers (Hayes & Fitzgerald, 2005). The commercialisation stage of innovation is likely to require repeated interactions between these occupational cultures.

The potential existence of multiple cultures within one organisation, with links between the boundaries of distinctive social systems leads to questions regarding the role of organisational and occupational cultures in hybrid industry-research organisations. This chapter reviews the literature related to subcultures, their boundaries and the specific characteristics attributed to research and managerial occupational subcultures. Then, chapter four combines the topics of innovation, organisational culture, and research and commercial occupational subcultures in the examination of existing studies of commercial and research groups in hybrid industry-research centres in general, and within Australian CRCs.

3.2 Subcultures in Organisations

Subcultures are defined as unique patterns of values and philosophies that are shared by a group, and that differ from, but are compatible with the dominant culture of the organisation (Trice, 1993). In this, they differ from countercultures. Countercultures reject organisational values, and are in open conflict with the parent organisation. According to Kunda (1992), every large organisation consists of potential subcultures based on characteristics such as gender, ethnicity, profession, age, functional division or geographic location, wage levels and employment status. The mental models, “thought worlds” or shared systems of meaning held by occupational groups within a single, commercial organisation have been shown to present barriers to innovation (Dougherty, 1992; von Meier, 1999). Therefore, it is appropriate to pay attention to the potential impact of occupation-based subcultures on innovation outcomes in hybrid organisations.

The Nexus approach to the study of culture (J. Martin, 2002; Meyerson & Martin, 1987) views the organisation as a receptacle for a variety of subcultures imported from its environment. Nexus literally means the connection between members of a group, and suggests a need to study cultures in organisations, rather than
organisational culture. The organisation provides an environment in which subcultures form and change. The boundaries of organisational culture are not viewed as stable, impermeable or clear in the Nexus model of organisational culture. Instead, organisations are thought of as pluralistic, being composed of subcultures. The occupational subcultures of professions such as nurses and computer programmers may be stronger than the culture of the organisations in which they are employed, particularly if they often move between employers but do not change their occupation (Guzman & Stanton, 2004; J. Martin, 2002). In addition, evidence suggests that an engineering occupational subculture plays a larger role than ethnic background in determining its members view of learning behaviour (Hyland, Gieskes, & Sloan, 2001). Therefore, if the members of occupations present in CRCs identify more strongly with the norms of their occupation than the employing organisation, their work cultures may be imported. In summary, a three-perspective view of organisational culture combined with nexus theories of importation of occupational cultures may have potential to explain the workings of hybrid industry-research centres engaged in commercialisation.

3.3 Sub-cultural Boundaries

The notion of boundaries, or borders between organisational subcultures is central to this research. Understanding the characteristics of any occupational subcultural boundaries present in Australian CRCs in terms of their shape, thickness and permeability may provide opportunity to improve organisational process and commercialisation outcomes.

Increasingly, the social sciences use boundary concepts to examine interactions between individuals, groups and nations (Lamont & Molnar, 2002). In the context of innovation studies, boundary concepts have been used to describe and explain interactions between groups of scholars and practitioners, (T. Kuhn, 2002; Lehrer & Asakawa, 2004; Nowotny et al., 2001; Turpin & Deville, 1995; Van Maanen & Barley, 1984; Ziegler, 1997). Boundaries between different research disciplines have also been examined, (Epton et al., 1983; Gibbons et al., 1994; Turpin et al., 1996) as have the borders between ‘hard’ and social sciences, (Gieryn, 1999). Theoretical
applications of boundary concepts to occupational culture include Douglas, (1982), E. Martin, (E. Martin, 1998), Lamont and Molnar (2002), Turpin (1999) and J. Martin (J. Martin, 2002). Lamont and Molnar (2002, p. 168) draw a distinction between social and symbolic boundaries, describing social boundaries as manifested in unequal access to and unequal distribution of resources, while symbolic boundaries are based upon conceptual categorisations of objects, people and practices. As my research explores evidence of occupational subcultures rather than resource allocation in four CRCs, symbolic boundaries receive attention and analysis in this thesis.

The constructs, or inferred concepts (D. R. Cooper & Schindler, 1998) frequently used to describe and analyse symbolic boundaries between groups include permeability, salience, durability, and visibility. Permeability refers to whether members of other groups are able to cross a boundary while durability concerns the longevity and resilience of group boundaries. Salience indicates the relative importance of boundaries to the functioning of the group and visibility describes the ease of with which boundaries can be perceived.

Key boundary mechanisms include activation, maintenance, disputation, crossing and dissolution, as boundaries morph into new categories or hybrids (Lamont & Molnar, 2002).

### 3.4 Occupational Subculture or Professional Identity?

Professional identity theory is applicable to occupations that meet the historical criteria for professional status. Trice and Beyer (1984) describe rites and ceremonies that act to distance professionals from their employers and bind them, instead, to their professional colleagues. However, the occupations typically working in commercialisation, such as scientists, engineers and managers, do not meet all professional criteria, which are: autonomy of operation, self-regulation of criteria for admission or continuing membership and attempts to dominate a market in knowledge-based services (Bailyn, 1985; Fitzgerald, 2002; J. T. Gray & Clegg,
Furthermore, Van Maanen and Barley (1984) posited that ‘… the professions, when appropriately unpacked by speciality and interest, are best viewed as occupational communities’ which differ from other occupations only in their relative autonomy (1984, p. 287). Consequently, in examining interactions between research and managerial groups engaged in commercialisation activities, occupational cultural rather than professional identity theories offer an opportunity to make meaningful comparisons.

### 3.5 Occupational Subcultures in Commercialisation

Physical and social conditions drive the creation of occupational communities, which in turn create and sustain work cultures (Van Maanen & Barley, 1984). Occupational characteristics of danger, stigmatisation (or social elevation), beliefs of socially valued, unique abilities, and claimed responsibility for others are factors which markedly encourage perceptions of separateness and exclusivity (Fitzgerald, 2002; Trice, 1993; Van Maanen & Barley, 1984). However, before exploring occupational subcultures in commercialisation, it is necessary to justify the relevance of literature regarding management, as distinct from leadership, to the research. While emphasis is placed upon leaders and leadership in popular and academic texts (see for example, Hesselbein, Goldsmith, & Beckhard, 1996; Kouzes & Posner, 1987), most day-to-day contact between researchers and commercial people occurs in the context of management: planning, organising, controlling and coordinating project related tasks. The following section justifies the application of managerial culture to CRCs.

The recommendations of the 2003 CRC evaluation report (Department of Education Science and Training & Howard Partners) emphasise measurement, inspection and reporting activities with the objectives of increased commercial adoption of, and financial returns from public research. Over half of the recommendations deal with the strength of investment propositions submitted, reporting CRC outputs and outcomes and ‘assessing the achievements of the CRC against credible milestones’ (Department of Education Science and Training & Howard Partners, 2003, p. xxi). Without diminishing the potential for individuals to demonstrate leadership in their
role, common interactions within CRCs will involve inspection and reporting of results, such as the project management of schedules or the financial management of budgets. In this environment, managerial orientations towards control, communication and coordination are likely to be evident. Consequently, this review draws upon the literature related to managerial occupational culture.

Before comparing managerial and research occupational subcultural literature, it must be emphasised that all cultures have positive and negative aspects and, ‘Ultimately cultures cannot be judged except in relation to some goal we are trying to accomplish’ (Schein, 1995, p. 20). The next section of this chapter explores the established features of research and managerial occupational subcultures in preparation for discussion of their simultaneously complementary and oppositional roles in innovation.

3.6 The Occupational Culture of Researchers

These [scientific research] communities can serve as an example of an extreme case of effective social control by a minimum of informal sanctions. … They comprise one of the interesting instances where a group of people is held together by a common purpose and shared norms without the need of reinforcement by familial, ecological, or political ties (Ben-David, 1971, pp 4 - 5).

Numerous contributions from history, sociology and anthropology exist to substantiate the claim that researchers share a culture (Traweek, 1993), which, consistent with the nexus view, may be imported into an organisation to function as a distinctive subculture. Scientists have been explicitly identified as insulated from their social milieu, bound together by a common language, using occupation specific rituals and comprising the exclusive audience for, and judges of, each other’s work (Geraci, 2002; T. S. Kuhn, 1970, 1977; Tullock, 1993). Several studies (Cole, 1992; Gieryn, 1999; Merton, 1957, 1968; Pelz & Andrews, 1976; Steiner, 2000) have identified institutionalised norms that direct the behaviour of scientists, (including free sharing of findings, universalism, disinterestedness and organised scepticism), internalised through socialisation and training. These norms are reinforced by systems of reward and sanctions largely based upon the esteem and approval of
peers, and are viewed as essential for the pursuit of certified knowledge. In fact, the hardest problems require the biggest teams, and there has been acknowledgement that the critical issues in research are now as much social as technical (Button & Sharrock, 1998). In short, research involves more than hypotheses and equipment. It also involves communication and occurs in a socio-cultural context involving members of specialised occupational cultures, also referred to as “communities of practice” (T. Kuhn, 2002), or “disciplinary matrixes” (T. S. Kuhn, 1977).

According to some social scientists (Bailyn, 1985; Bloor & Bloor, 1982; Gieryn, 1999; Merton, 1957, 1968; Pelz & Andrews, 1976; Tullock, 1993; Ziman, 2000) a research culture, based upon the use of scientific method and adherence to common norms of behaviour, has been observed to operate across disciplines and national cultures, and in varied settings, including public and private organisations. In this thesis, the term *research culture* is used to encompass organisational settings within and outside academia, and to acknowledge its relevance to newer disciplines such as computer science. This terminology is also consistent with that used by the Australian Department of Education, Science and Technology in its CRC evaluation reports (CRC Program Evaluation Steering Committee, 1995; Department of Education Science and Training & Howard Partners, 2003).

However, it is possible that more than conventional research skills are required to be an innovator or to produce knowledge of interest to industry. The assumptions, values and norms inculcated in a good scientific education may be counter-productive. This is due to the conflict exists between scientific mental models that view knowledge making as the desired goal and commercial mental models devoted to moneymaking. A boundary-crossing innovator-manager, possessing multiple occupational cultural frames and able to decide when to be a “good” scientist and work by the book and when to be “incompetent” and digress from accepted scientific practice can be invaluable in commercialisation (Epton et al., 1983; Kassicieh & Radosevich, 1993; Quirk, 2005; Steiner, 2000; Turpin et al., 1996).

In summary, research culture exists, transcends national and organisational settings and is a likely candidate for importation in hybrid research organisations.
3.7 Environmental Forces and Research Culture

… external pressures for change do not have any mechanical effect on research practices and ideals, as they are always filtered through the historically, socially and cognitively constructed stock of values, norms and codes of behaviour… This means that the cultural elements act as a “buffer” that to a certain extent can save university research from being a mere target of the external steering by economical and political actors (Hakala & Ylijoki, 2001, p. 378).

National systems of innovation and the rise of “Mode 2” knowledge production (for practical application, carried out in non-hierarchical, transient organisations that are separate from university structures (Gibbons et al., 1994; Nowotny et al., 2001) are environmental forces which impact research culture. External pressures for change, such as expectations of a financial return, can influence the boundaries and strength of occupational subculture (Trice, 1993). Since the early 1990s, successive Australian governments have sought to encourage collaborative research projects between industry and publicly funded research institutions, such as the CSIRO (Commonwealth Scientific and Industrial Research Organisation). Criticisms of public policy, which increasingly makes receipt of public research funding contingent upon participation in industry linked projects, highlight the potential for conflict between research norms and commercial proclivities for speed, confidentiality and profit (G. Harman, 1999, 2001). Academics have investigated the research community’s response to pressure to produce increasingly commercially oriented work in Australia (G. Harman, 1999, 2001; Turpin, 1999), Finland (Hakala & Ylijoki, 2001) and the USA (Louis, Blumenthal, Gluck, & Stoto, 1989). These intra-occupational studies serve to illustrate the dynamic nature of subcultures. Significantly, they also point to the need for inter-occupational studies of government-sponsored commercialisation efforts. Hence, inter-occupational comparisons are needed to obtain balanced insights into the process of innovation, which of necessity spans research-producing and research-using occupational cultures and organisations.
3.8 Managerial Occupational Culture

Sociological studies of science and researchers started to appear in the late 1950s, (Traweek, 1993) but managerial culture is a more recent area of study. While the tasks and responsibilities of management have been extensively examined, and conceptualised by Classical, Scientific, Bureaucratic and Human Relations schools of management theory (Wood et al., 2004) managerial culture has attracted less attention. Consequently, there is less literature concerning managerial culture than research culture.

Trice (1993) identified the existence of a powerful executive management subculture within organisations. He described the outward attributes of management subculture, such as frequent formal and informal meetings between members using primarily oral communication and physical isolation from lower status workers. Difficult issues, especially those dealing with current and future uncertainty were passed up the hierarchy of the organisation to a typically male group, who shared accounting or finance training and had links to social networks in their communities. Other features of management culture included the use of rational ideology and techniques, acquired through socialisation in university business schools, to justify the power gap between them and other employees, and the recruitment of individuals perceived to be similar to themselves to the ranks of management. Furthermore, Trice identified managerial culture as a driving force in the de-skilling of many occupations.

Focussing more on beliefs, values and assumptions, Schein (1995) identified managerial culture as an inhibitor to organisational transformation and learning. Specifically, a worldwide culture of management, (although Schein acknowledges his use of a US perspective based upon familiarity and its dominant position in the production of management theories) inhibited the development of learning organisations primarily by means of shared managerial assumptions. These assumptions included the belief that managers had to be in control, decisive, certain and dominant at all times; furthermore, “lone problem solvers” were regarded as heroic. Individual competition was seen as the natural state while teamwork was viewed as a practical necessity rather than intrinsically desirable. A competition based work hierarchy provided security and status, and senior managers acted in ever
more decisive and controlling ways to express that status. Managers were viewed as sharing an implicit model, indoctrinated in business schools that ‘… management deals with hard things – data, money, bottom lines, payoffs, production, competition, structure. And it is even better if these hard things can be quantified’ (Schein, 1995, pp. 18 - 19). Task issues were given precedence over relationship issues, a perquisite of management status was to be able to stop learning, and short-term plans regarding short-term goals characterised the managerial orientation to time.

The cultural attributes ascribed to managers by scholarly writers are uninspiring at best and unflattering at worst. For example, Schein and Trice identified management culture as an obstacle to, rather than a catalyst for high organisational performance in the early 1990s. Furthermore, Nemeth (1997, p. 59) linked the use of strong organisational culture to ‘… achieve productivity and high morale…’ with reductions in ‘… creativity, innovation and an ability to respond readily to change.’

In the years since Trice’s, Schein’s and Nemeth’s studies (1993, 1995 and 1997 respectively) of managerial culture, it is possible that managerial culture has changed. Flattened organisational hierarchies, the use of information technology and management education are factors that may have contributed to a change in management culture. However, recent research continues the critical view of management culture in the academic literature. For instance, managerial norms of recruitment based on perceived similarity and ‘An overbearing need for staff to conform to the behaviours and expectations of the organisational norm …’ (Pech, 2001, p. 559) are considered root causes of low organisational innovation and creativity. The use of managerially created and monitored norms to enforce conformity in business dress, language and values has been implicated in the collapse of Enron (Tourish & Vatcha, 2005). Furthermore, the socialising effect of MBA studies within business schools is charged with ‘encouraging a separate, privileged elite … imposed on people without their consent’ (Mintzberg, 2004, p. 143). Even more damning, managerial culture is presented as evolving into “organisational narcissism” (Zuboff, 2004).

The occupational cultural literature clearly supports the existence of distinct managerial (Mintzberg, 2004; Pech, 2001; Schein, 1995; Trice, 1993) and research (T. Kuhn, 2002; T.S Kuhn, 1970, 1977; Merton, 1957; Steiner, 2000; Traweek,
1993) occupational cultures. Having examined the literature related to research and commercial occupational subcultures separately, the thesis will proceed to compare theoretical conceptions of the two occupational cultures, in preparation for empirical comparison in the results chapter.

3.9 Surface Similarities, Deep Differences

When compared to occupational cultures such as those of the police officers and dockworkers reported by Trice (1993), the occupational cultures of researchers and managers may appear similar. Outwardly, they share an emphasis on rational, empirical measurement, work towards future oriented goals and generally labour in office environments in the employ of an organisation. As in business, men have traditionally dominated science and technical fields of research (Fara, 2004). Both managers and researchers are viewed as knowledge-bearing elites with vital roles to play in national systems of innovation (Ziegler, 1997). Furthermore, analogous to the “lone hero” in business (Schein, 1995), cultural stories of the solitary genius who solves an intractable problem and single-handedly propels humanity to a better future are a salient feature of research culture (Bragg, 1998; T. S. Kuhn, 1970).

However, cultural assessments based upon apparent similarities may result in misconceptions. Using the occupation of common territory and possession of similar backgrounds to define occupational communities has been criticised as ‘… especially misleading’ (Van Maanen & Barley, 1984, p. 295). Furthermore, as Schein has asserted, the deepest levels of culture are cognitive: ‘… thought processes that the group comes to share will be the ultimate causal determinant of feelings, attitudes, espoused values, and overt behavior’ (Schein, 1990, p. 111). The previous sections have considered occupational groups of researchers and managers in detail, using previous research to travel beyond visible or “surface” similarities to identify the assumptions, values and norms of managerial and research occupational cultures.

Despite these similarities, and putting aside for now the potential for the reputation of managerial culture to create a barrier to collaboration in itself, areas of difference
between managerial and research cultures may exist in attitudes towards occupational autonomy and the free sharing of knowledge as opposed to control and confidentiality (Bailyn, 1985). Also, reliance upon extrinsic rewards as motivators in industry may conflict with the tradition of mainly intrinsic rewards of researchers, although Merton (1968) has linked recognition with an academic hierarchy in which the prestige accumulated through publication lead to improved access to facilities and money.

The interactions of scientific and management occupations are likely to reflect the dynamic positions of dominance and submission generated by the allocation of scarce resources within an organisation. Additionally, in the same way as professions such as law, medicine and religious orders operate with an interpretive schema guiding their individual professional behaviour managers, engineers and scientists are likely to recognise from their education and socialisation, the “right” behaviour for their organisational role.

Thus far, the review of organisational culture and innovation literature has shown that the dominance of studies using a single, mainly integrationist perspective of organisational culture has resulted in a “blind spot” in relation to occupational subcultures in innovation. The rapid and global increase in the use of hybrid industry-research organisations to support national innovation objectives gives impetus to review these organisations from another perspective, that of organisational cultural differentiation, and to consider the potential for occupational subcultures to exist within and influence the outcome of commercialisation efforts.

Chapter 4 combines the topics of occupational subcultures and innovation in the examination of recent innovation studies that have acknowledged organisational culture and studies of commercial and research groups in hybrid industry-research centres.
Chapter 4

Hybrid Organisations and Australian Cooperative Research Centres

4.1 Introduction

Our country has enormous talent and we have always been skilled at capitalising on our vast natural resources. But the future we aspire to – a healthier, sustainable and prosperous community – will depend increasingly on our capacity to develop ideas, to build new high growth industries, to apply knowledge in new ways to old industries, and to fashion intelligent solutions for the social and environmental problems we face.

The Australian Government’s $3 billion Innovation Statement, Backing Australia’s Ability, underscores its drive to build Australia’s strong economic and social future. It is the highest level of long-term commitment of any Australian government to fostering new knowledge and innovation through research, commercialisation and skills development (Science and Innovation Mapping Taskforce, 2003, p. i, Foreword by the Australian Minister for Education, Science and Training).

As the Australian CRC program is a creation of the Federal Government it is fitting that this chapter should start with a quote from a politician, outlining the justification for, and the aims of the program. CRCs are a governmental intervention with two main objectives. First, to produce an economic benefit from Australia’s investment of public monies in research institutions and second, to increase the proportion of national R&D expenditure contributed by Australian businesses. The above quote also communicates strength of intent and clear financial commitment, and it is noteworthy that the CRC program has survived changes in the incumbent political party. In the Australian innovation system, governmental inducements have been necessary to encourage members of research institutions and commercial companies to work together (Barlow, 2006; Liyanage & Mitchell, 1993). Private Research and Development spending is proportionately lower in Australia than in other countries (Barlow, 2006; Science and Innovation Mapping Taskforce, 2003) and research and
business communities have, traditionally, had few points of interaction (Australian Research Council (ARC), 2001).

The literature review continues in this chapter, through investigation of the organisational context of the research. This chapter situates the Australian CRC program within the context of hybrid industry-research organisations. Hybrid organisations are examined with reference to the review of organisational culture, innovation and occupational culture presented in Chapters 2 and 3. Then, summaries of the methods and findings of previous studies that use organisational cultural theory to examine hybrid organisations are presented in tabular format. A summary of existing research relating to the Australian CRC Program follows. Finally, the chapter enunciates the research questions and the contribution to knowledge made by this research.

4.2 Hybrid Industry-Research Organisations

From the 1980s, governments of industrialised economies have looked to innovations involving the generation of, and reconfiguration of knowledge as a means of maintaining their competitive advantage (Gibbons et al., 1994; Lehrer & Asakawa, 2004; Nowotny et al., 2001; Premus, 2002). As described in section 4.4, government funding policy in Australia changed in 1990 to encourage research institutions, commercial organisations and government bodies to work closely together in commercialising promising ideas and technologies. Australian researchers participating in university industry linkage programs report knowledge advancement, additional funding and strategic benefits from their involvement (Plewa & Quester, 2005). From a business perspective, the attractions of entering a collaborative research organisation include access to complementary physical and intellectual assets, reduced time and costs for product development, and increased organisational and financial flexibility (Senker & Sharpe, 1997). The creation of hybrid organisations that use resources and/or governance structures from more than one existing organisation (Borys & Jemison, 1989), has been a feature of the organisational response to government and business pressures. The evolution of
“Triple Helix” organisations, in which private firms and publicly funded research groups collaborate with the support of government funding, has been traced across Europe, the USA, Latin America and Asia (Etzkowitz & Leydesdorff, 2000). In addition to rapid geographical spread, the number of hybrid industry-research centres has also increased quickly (Cyert & Goodman, 1997; D. O. Gray et al., 2001; Premus, 2002) as has the percentage of industry and government funding they attract (D. O. Gray et al., 2001; Tornatzky et al., 1999). The operation of hybrid industry-research organisations is a clearly subject worthy of attention given their recent conception and rapid adoption.

Hybrid industry-research organisations share some of the management challenges encountered by joint-venture partners from the same industry. For example, boundary issues between the partner organisations, threats to the hybrid organisations stability from the sovereignty of member organisations, and the challenge of reconciling at times disparate goals, technologies and organisational cultures can occur when commercial organisations, in the same industry, combine, as has occurred with HP and Compaq in the IT industry (Borys & Jemison, 1989; Burgelman & McKinney, 2006). Organisations that represent temporary collaborations between industrial and research partners are likely to encounter even more complicated structural, managerial and organisational cultural challenges than those that have made mergers and acquisitions into acknowledged high-risk endeavours (Barringer & Harrison, 2000).

In hybrid industry-research organisations, the initial stages of innovation, including the identification, capture and evaluation of new knowledge, are increasingly conducted across organisational and occupational boundaries, and authority structures may be unclear in such temporary alliances. The experience of inter-occupational contact in hybrid industry-research organisations forms the focus of this work and provides useful new insights into this relatively uncharted area.

Organisational cultural concepts may be regarded as inapplicable to temporary, hybrid organisations. The absence of a long, collective history, during which shared norms and beliefs can be developed, is cited as a barrier to the development of organisational culture in hybrid organisations (Barringer & Harrison, 2000; Singh,
2003). For instance, an extensive review of the inter-organisational relationship literature (Barringer & Harrison, 2000), after briefly noting the need to align the cultures of corporate alliance partners, proceeded to apply six theoretical paradigms. Transaction Costs Economics, Resource Dependency, Strategic Choice, Stakeholder Theory, Organisational Learning and Institutional Theory, but not organisational culture, to explain the advantages and disadvantages of participation. The traditional, integrationist perspective of organisational culture with its emphasis on consistency, certainty and coherence within an organisation is poorly equipped to address the cultural and structural complexity of hybrid organisations. In short, an integration perspective of organisational culture is not immediately apparent in hybrid organisations.

However, differentiation and fragmentation perspectives are able to embrace the shifting alliances and lasting sub-groupings that characterise hybrid organisations (Pitsis, Kornberger, & Clegg, 2004). For instance, van Marrewijk (2005), in examining the dilemma of control versus commitment in a construction mega-project in The Netherlands, traced the evolution of organisational culture within a hybrid organisation composed of private companies, government departments and research partners. In this inter-organisational alliance, created to oversee a construction mega-project, formal protocols for collaboration were developed in an attempt to reduce occupation-based conflict. However, the protocols proved insufficient to prevent covert, followed by overt withdrawal of one partner organisation. It is possible to accommodate evidence of tension and apparent cultural contradictions in a hybrid organisation within a differentiation or fragmentation, but not an integration framework of organisational culture. Furthermore, the dynamic nature of organisational culture, illustrated through the eventual appearance of an integrated organisational culture that complemented the pre-existing member cultures, is also apparent. Therefore, all three of Martin and Meyersons’(2002; 1987) cultural perspectives have potential application in hybrid organisations.

Having established that organisational cultural concepts are applicable to hybrid organisations, the following section summarises previous innovation and hybrid organisation research that has incorporated organisational cultural concepts in either design or discussion. These studies are then synthesised to identify previous
approaches to the topic of innovation, hybrid organisations and organisational culture and to identify “holes” in the literature. Existing studies of Australian CRCs are reviewed separately in section 4.4.4.

4.3 Hybrid Organisations, Innovation and Organisational Culture

The problem addressed by this research is that while the successful market launch of an innovation is acknowledged to be highly unlikely (Quinn, 1985; Singh, 2003), to the extent that such events have been described as “statistical outliers” (Matthews & Frater, 2003), insufficient attention has been paid to the experience of people from both research and commercial occupations. Little is known about how occupational interactions are perceived to influence commercialisation outcomes by members of research and commercial occupational subcultures working in hybrid industry-research centres. To address this gap in knowledge, the study explores the experience and impact of inter-occupational subcultural interaction from the perspective of people from research and commercial groups directly engaged in commercialisation activities.

The operation of hybrid industry-research organisations have been studied through structural foci, such as age, size and funding (D. O. Gray et al., 2001; Liyanage & Mitchell, 1993). While some recent studies have used theories of organisational culture in their discussion (Couchman & Beckett, 2006; Riedlinger et al., 2004), and others have applied a cultural frame to Australian research partners in CRCs (Turpin, 1999), culturally focussed and conceptually driven work analysing the perceptions and experiences of both research and commercial occupational subcultures is largely absent from the CRC literature.

A number of points regarding the state of organisational cultural research into innovation in hybrid organisations other than Australian CRCs appear from examination of Table 4.1, below. First, consistent with the general pattern of organisational cultural research (J. Martin, 2002), the majority of studies employ a single, integrationist view and originate in the USA. Of the eighteen studies and
papers summarised in this chapter, twelve are written by scholars from the United States and of the remaining six, four are from the UK. Second, the variety of theoretical perspectives applied to innovation in hybrid organisations is of interest. Organisational culture concepts provided the primary research focus for only four of the eighteen studies, with the majority referring to the impact of culture only in results and discussion sections. Third, consistent with the rapid increase in the number of hybrid organisations in the 1990s, the early studies are mainly theoretical, with empirical work only appearing in the mid 90s. Fourth, the use of more than one perspective of organisational culture occurs more frequently in the later studies. However, it is of interest that a differentiation view was applied in early research considering the challenges inter-disciplinary work presented within traditional, faculty-oriented research organisations (Chakrabarti & Schneider, 1990; Friedman & Friedman, 1990).

In addition, seven of the eighteen studies of hybrid organisations engaged in innovation are literature reviews and theoretical contributions. Qualitative research dominates the remaining studies, and a collective case study is the most frequently used research design (Lam, 2005; Premus, 2002; Senker & Sharpe, 1997; Siegel et al., 2004). Mixed methods account for two (Bruce et al., 1995; Santoro & Gopalakrishnan, 2000) and quantitative methods for one (D. O. Gray et al., 2001) of the studies. Finally, of the studies that use organisational culture as their principal focus, (Friedman & Friedman, 1990; Hoch, 1991; Siegel et al., 2004; van Marrewijk, 2005), Siegel et al’s study is closest to the research conducted for this thesis. However, as their study focussed on Technology Transfer Offices working to identify and license university intellectual property, the primary informants were technology transfer officers, intermediary actors employed by universities to bridge research and commercial occupational communities, rather than members of research and commercial groups directly engaged in commercialisation. Hence, organisational culturally focused and conceptually driven research into inter-occupational relationships in commercialisation, dealing directly with both commercial and research subculture members, appear to be missing from the innovation literature.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Provenance</th>
<th>Research Method</th>
<th>Organisation Type</th>
<th>Theoretical Perspective</th>
<th>Cultural Perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>Borys &amp; Jemison</td>
<td>USA</td>
<td>Theoretical, Review of Previous Research</td>
<td>Creates typology of hybrid organisations, from acquisitions to supplier arrangements</td>
<td>Theory of Hybrid Organisations</td>
<td>Integration, differentiation and fragmentation perspectives</td>
</tr>
<tr>
<td>1990</td>
<td>Chakrabarti &amp; Schneider</td>
<td>USA</td>
<td>Theoretical Paper</td>
<td>Universities in receipt of private project funding</td>
<td>Conflict Management and Resolution</td>
<td>Differentiation of disciplinary or faculty cultures within each university</td>
</tr>
<tr>
<td>1990</td>
<td>Friedman &amp; Friedman</td>
<td>USA</td>
<td>Theoretical Paper</td>
<td>Organised Research Units within Universities</td>
<td>Organisational Structure and Culture</td>
<td>Differentiation</td>
</tr>
<tr>
<td>1995</td>
<td>Duke</td>
<td>USA</td>
<td>Theoretical Paper</td>
<td>University – Industry Alliances</td>
<td>Intra and Inter-Organisational Conflict Resolution</td>
<td>Integration</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Provenance</td>
<td>Research Method</td>
<td>Organisation Type</td>
<td>Theoretical Perspective</td>
<td>Cultural Perspective</td>
</tr>
<tr>
<td>------</td>
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<tr>
<td>1995</td>
<td>Bruce, Leverick &amp; Littler</td>
<td>UK</td>
<td>Mixed Method. Quantitative Mail Survey and two case studies</td>
<td>Inter-Firm Collaborative Product Development</td>
<td>Increased Speed and Reduced risk as Benefits of Collaborative Product Development</td>
<td>Integration</td>
</tr>
<tr>
<td>1997</td>
<td>Cyert &amp; Goodman, 1997</td>
<td>USA</td>
<td>Theoretical based on Experience</td>
<td>University-Industry Alliances</td>
<td>Organisational Learning</td>
<td>Differentiation</td>
</tr>
<tr>
<td>1997</td>
<td>Senker &amp; Sharpe</td>
<td>UK</td>
<td>Qualitative, Collective Case study and interviews with seven US/Euro partners in collaboration</td>
<td>Cooperative Research Alliances between Biotechnology Firms</td>
<td>Network Organisations and Incentives to Collaborate</td>
<td>Integration view at National level of culture</td>
</tr>
<tr>
<td>1999</td>
<td>Davenport, Davies, &amp; Grimes</td>
<td>New Zealand</td>
<td>Qualitative, Structured Interviews with Industry Managers</td>
<td>Dyadic, contractual industry-research relationship</td>
<td>Government Policy and the establishment of multi-dimensional trust</td>
<td>Integration view introduced in Discussion</td>
</tr>
<tr>
<td>2000</td>
<td>Santoro &amp; Gopalakrishnan</td>
<td>USA</td>
<td>Mixed methods applied to industry partners</td>
<td>Industry-University Cooperative Research Centres &amp; NSF supported Engineering Research Centres</td>
<td>Organisational factors influencing Knowledge Management</td>
<td>Integration</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Provenance</td>
<td>Research Method</td>
<td>Organisation Type</td>
<td>Theoretical Perspective</td>
<td>Cultural Perspective</td>
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<tr>
<td>2000</td>
<td>Barringer &amp; Harrison</td>
<td>USA</td>
<td>Theoretical, Overview of Literature on Inter-organisational Relationships</td>
<td>Joint Ventures, Networks, Consortia, Alliances, Trade Associations and Interlocking Directorates</td>
<td>Transaction Costs Economics, Resource Dependency, Strategic Choice, Stakeholder Theory, Organisational Learning and Institutional Theory</td>
<td>Integration</td>
</tr>
<tr>
<td>2001</td>
<td>Logar, Ponzurick, Spears &amp; France</td>
<td>USA</td>
<td>Qualitative, Case Study</td>
<td>University – Industry Alliances</td>
<td>Innovation Process Theory</td>
<td>Integration</td>
</tr>
<tr>
<td>2002</td>
<td>Premus</td>
<td>USA</td>
<td>Qualitative, Collective Case Study</td>
<td>Start-up companies commercialising public research</td>
<td>National Systems of Innovation and Technology Diffusion from Public to Private Sectors</td>
<td>Integration view at level of National culture</td>
</tr>
<tr>
<td>2003</td>
<td>Singh</td>
<td>USA</td>
<td>Theoretical Paper</td>
<td>Network Organisations involved in technology transfer</td>
<td>Application of social network and stakeholder theories</td>
<td>Integration</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Provenance</td>
<td>Research Method</td>
<td>Organisation Type</td>
<td>Theoretical Perspective</td>
<td>Cultural Perspective</td>
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</tr>
<tr>
<td>2004</td>
<td>Siegel, Waldman, Atwater &amp; Link</td>
<td>USA</td>
<td>Qualitative, Collective Case Study, Structure Interviews</td>
<td>Technology Transfer Offices licensing University Intellectual Property</td>
<td>Stakeholder, IP and Organisational Culture</td>
<td>Integration and Differentiation</td>
</tr>
<tr>
<td>2005</td>
<td>van Marrewijk</td>
<td>Netherlands</td>
<td>Qualitative, Case Study</td>
<td>Public/Private Mega-Project Construction Alliance</td>
<td>Control and Commitment, Organisational Culture</td>
<td>Differentiation evolving to include an Integration Perspective over time.</td>
</tr>
<tr>
<td>2005</td>
<td>Lam</td>
<td>UK</td>
<td>Qualitative, collective case study, semi-structured interviews</td>
<td>University-Industry Network Organisations</td>
<td>Economic, extended internal labour markets</td>
<td>Integration</td>
</tr>
</tbody>
</table>
4.4 Australian Cooperative Research Centres

Having examined studies located at the intersection of innovation, organisational culture and hybrid organisational research, this chapter continues with a review of extant research on Australian CRCs.

This section of the literature review presents the key features of the CRC program and comments on government evaluations and public perceptions of the program. The basis of this analysis is material published by the Australian government, by newspapers and by business journals. The information contained is important to the thesis proposition because it provides background information helpful in understanding the organisational context of the research.

4.4.1 Summary of the CRC Program

CRCs are composed of academic, government and industry members working together to bring an invention to market and operate as trans-disciplinary, inter-organisational, temporary organisations, intended to link discovery, application and use. The Australian CRC Program, established in 1990 by the federal government, aims to improve the effectiveness of Australia’s research and development effort. Close interaction between scientific and commercial organisations to guide research and development efforts towards utilisation and commercialisation is a key feature of the CRC program (CRC Program Evaluation Steering Committee, 1995; Department of Education Science and Training & Howard Partners, 2003; Liyanage & Mitchell, 1993; Ridge, 2000). Additional policy objectives include the maintenance of Australian ownership of Intellectual Property, provision of training positions for postgraduate students and the inclusion of groups located in regional areas, beyond the major cities (De Blas, 2004; Department of Education Science and Training & Howard Partners, 2003, pp. 151 - 152).

In 2006 seventy one CRCs were receiving funding, with A$925.9 million being provided for administered grants between 2006–07 and 2010–11 (Department of Education Science and Training, 2006). Reviews of the program in 1995 and 2003
have resulted in progressive refinements, and the current main objective of the 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 levels of outcomes in adoption and commercialisation (Department of Education Science and Training, 2006, p. iv).

Funding for the program has been increased by an additional A$65 million over the years to 2009-10 and the government has committed to hold a CRC selection round in 2008. Since 1990 all parties have committed more than $11,030 million (cash and in-kind) to CRCs. This includes A$2650 million from the CRC Program, A$2884 million from universities, A$2131 million from industry, A$1267 million from State Governments, A$1195 million from CSIRO, A$466 million from other Australian Government agencies and A$479 million from other institutes (Department of Education Science and Training, 2006). It is apparent that the program has predominantly been supported by public money, in a public to private ratio of approximately three to one.

While the CRC program has produced more than seventy spin-off companies with a total turnover expected to reach up to $300 million by 2007 (Young, 2003) it is viewed as a qualified success by politicians and has received much “sympathetic criticism”. It is applauded for its approach to fostering collaboration between industry and researchers, but at the same time:

There was a view expressed by many stakeholders, particularly those in the private sector, that the Programme had been too focussed on research with an insufficient emphasis upon meeting industry and other end-user needs through attention to adoption and application of research results. Some, but by no means all, of this criticism is justified. It is in this context that the Evaluation recommends that the Programme should be clearly positioned as an “investment” vehicle in which research is seen as a means to an end (“an end use”), not an end in itself (Department of Education Science and Training & Howard Partners, 2003, p. iii).

In the early years of the CRC program over eighty per cent of CRC professionals had a research background (Liyanage & Mitchell, 1993), with a thirteen per cent minority drawn from industrial and commercial sectors. It seems reasonable to expect at least one subculture, associated with the researchers who worked together in the “pre-history” of the CRC and guided the discovery through early commercial feasibility studies, to exist in the early stages of CRC development. CRCs are by definition
composed of groups with different skills. Consequently, subcultures broadly based on research and business professions may exist within CRCs.

### 4.4.2 Government Evaluations of the CRC Program

Research culture had been identified as a barrier to commercialisation in the ‘90s. The title of the 1995 CRC Program Evaluation steering committee’s report “CRC: Changing Research Culture” clearly communicated the government’s view that researchers needed to change. Its conclusion was that a successful transformation of research institutions and researcher culture was completed. For example:

> The major success of the CRC Program is in producing a culture change in Australian research and education activity in support of research and development and especially in interaction with industry and other research users. This culture change is a result of the synergistic approach to combining the four program objectives relating to research, user linkages, cooperation and education and training (CRC Program Evaluation Steering Committee, 1995, p. 6).

The 1995 Myer Report, in reviewing the achievements of the CRC program, declared synergy between business and research groups as the main achievement of the program’s first five years of operation (CRC Program Evaluation Steering Committee, 1995). The main recommendations of the report included the need for training for project and centre managers, incorporation of centres and the ability for centres to bid for a second round of funding.

A later, comprehensive evaluation of the CRC program was conducted with the objective of increasing the program’s efficiency and effectiveness (Department of Education Science and Training & Howard Partners, 2003). The 2003 review analysed existing documentation, conducted approximately one hundred telephone interviews to administer a structured questionnaire, held six workshops and invited written submissions. The report did not dwell on cultural matters apart from reiterating that the program had been ‘A powerful change agent in research culture – away from the “ivory tower” culture of universities.’ (Department of Education Science and Training & Howard Partners, 2003, p. 20). It focussed on CRC management board structures and the need to ensure CRCs were incorporated companies in the wake of some public disputes between members. The majority of
recommendations clearly aimed to improve measurement and reporting processes with the objective of enhancing returns on investment.

However, the 2003 report does contain indications that the 1995 evaluation may have been premature in its conclusion that research and industry were now able to work together synergistically. When asked about collaboration as part of the 2003 CRC program evaluation, CRC industry partners, responded as shown in Table 4.2.

Table 4.2: CRC Industry Partners’ View of CRC Researcher Collaboration

<table>
<thead>
<tr>
<th>How would you rate your agreement to the following statements:</th>
<th>Strong. Agree %</th>
<th>Agree %</th>
<th>Not sure %</th>
<th>Dis-agree %</th>
<th>Strong. Dis. %</th>
<th>N/A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRC researchers collaborate widely with my in-house researchers.</td>
<td>24</td>
<td>44</td>
<td>-</td>
<td>20</td>
<td>8</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>CRC researchers collaborate widely with end users and other organisations.</td>
<td>4</td>
<td>72</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>100</td>
</tr>
<tr>
<td>My in-house researchers collaborate widely with researchers from other participant organisations</td>
<td>28</td>
<td>24</td>
<td>8</td>
<td>28</td>
<td>8</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>My managers collaborate widely with CRC Managers.</td>
<td>24</td>
<td>32</td>
<td>8</td>
<td>24</td>
<td>8</td>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>


The 2003 CRC review results shown in Table 4.2 suggest that the population of industry partners is polarised in perceptions of collaboration. Approximately two thirds agree or strongly agree with statements describing collaborative behaviour. The remaining third disagree or strongly disagree. Few respondents are unsure or feel the questions regarding collaboration are not applicable. Furthermore, the results shown in Table 4.2 suggest that collaboration between scientific researchers and business professions in CRCs is strong in two thirds of the organisations, and failing in the remaining third. The surveys were completed with the participants’ knowledge that the results would be used by the Government to review the program. This knowledge may have potentially biased the survey results through reducing negative assessments from industry partners interested in the programs continued existence. Given previous reports of tension between distinctive research and managerial
occupational cultures (Pelz & Andrews, 1976), these results may represent stable, long lasting differences due to the existence of occupational communities whose members are trained, socialised and rewarded for behaving in distinctly different ways.

The responses of industry partners in hybrid research/commercial organisations lead to questions about the possible causes of such results. Can the polarisation be accounted for by individual, group or organisational factors, or perhaps by a combination of the three? This thesis investigates questions related to the interaction of organisational cultures and in particular, research and commercial occupational sub-cultures within the context of commercialisation processes.

4.4.3 Press Coverage of CRC Program Performance

Recently, CRCs have become newsworthy, reflecting their role in Australia’s national system of innovation and expectations of financial returns. More articles have been published in business magazines and newspapers than in scholarly journals. For example, using the ProQuest search engine to look for CRC* and Australia* in the abstract field produces the following breakdown of results.

<table>
<thead>
<tr>
<th></th>
<th>Scholarly Journals</th>
<th>Magazines</th>
<th>Trade Publications</th>
<th>Newspapers</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of articles</td>
<td>14</td>
<td>17</td>
<td>19</td>
<td>165</td>
</tr>
</tbody>
</table>

*Source: Proquest® Smart Search, November 10, 2006*

Public comment has variously announced the success, or lack thereof, of the CRC program. For example, “CRC Launch Promises $1 Billion in Benefits” (Ansell, 2003, p. 9), contrasted with “Great Idea, Shameful Return” (Gome, 2001, p. 47). The removal of “public good” and environmental research from CRC funding and governmental focus upon profit generation (Contractor, 2004; Contractor & Dodson, 2004; Murphy, 2004; P. Roberts, 2004) produced articles and letters of protest from...
the research community. The political objectives applied to CRCs make the program of interest to many stakeholders. These objectives include: demonstration of paths to commercial adoption, maintenance of Australian ownership of Intellectual Property (IP), provision of training grounds for post graduate students, encouraging the participation of Small and Medium Enterprises and establishment in regional areas, rather than major cities (De Blas, 2004). The CRC program has also attracted international attention (Cory, 2001) and has been described as an exemplar of industry-university collaboration (Young, 2003).

Notwithstanding the relatively high degree of public interest in the program, there has been relatively little academic examination of the program and research based, as opposed to theoretical papers touching upon occupational subculture are rare. The following section provides a summary of organisational cultural research related to Australian CRCs, and demonstrates the need for a targeted exploration of the potential impact of occupational subcultures on commercialisation outcomes, based upon the experiences and perceptions of people directly engaged in commercialisation in CRCs.

### 4.4.4 Organisational research: Commercialisation and CRCs

Between the years 1993 and 2006, six articles refer to organisational culture in CRCs (Couchman & Beckett, 2006; Garrett-Jones et al., 2005; Liyanage & Mitchell, 1993; Riedlinger et al., 2004; Turpin, 1999; Turpin et al., 1996). In all of these the research community was focus of interest with members of commercial occupations either ignored or receiving passing mention. In terms of methodology, two studies used mixed methods, two qualitative and the other two are theoretical. Reference to a broad variety of cultural forms is absent, as is in-depth analysis of the values and assumptions of the different communities. Table 4.4 below lists research studies relating to organisational culture and CRCs, and provides details of the studies summarised above.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Provenance</th>
<th>Research Method</th>
<th>Occupational Focus</th>
<th>Theoretical Perspective</th>
<th>Organisational Culture Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>Liyanage &amp; Mitchell</td>
<td>Australia</td>
<td>Mixed Methods, Successful CRC applications analysed and supplemented with interviews and CRC visits.</td>
<td>Researchers</td>
<td>Authority Structures and Organisational Strategies</td>
<td>Nexus, importation of research culture, movement towards corporate management styles.</td>
</tr>
<tr>
<td>1996</td>
<td>Turpin et al.</td>
<td>Australia</td>
<td>Qualitative. Comparison of Australian and Chinese university-industry research links.</td>
<td>Researchers</td>
<td>Creation of a typology of academic-industry alliances</td>
<td>Role of individuals in boundary permeability between research and commercial cultures and activities</td>
</tr>
<tr>
<td>1999</td>
<td>Turpin</td>
<td>Australia</td>
<td>Theoretical paper using preliminary observations from a study of Australian research cultures.</td>
<td>Researchers</td>
<td>Application of Douglas’ Group/Grid Dimensions of Culture</td>
<td>Creation of a typology of four research cultures associated with different social contexts in industry-university alliances</td>
</tr>
<tr>
<td>2004</td>
<td>Riedlinger, Gallois, McKay &amp; Pittam</td>
<td>Australia</td>
<td>Mixed Methods, Focus Groups and Questionnaire Specialists from CRCs</td>
<td>Communication Specialists from CRCs</td>
<td>Social Identity and Communication Theory</td>
<td>Differences in norms and values of partner organisations and between research communities identified as one of the challenges to intra-CRC communication.</td>
</tr>
<tr>
<td>2005</td>
<td>Garrett-Jones, Turpin, Burns &amp; Diment</td>
<td>Australia</td>
<td>Qualitative, interviews with researchers and research managers</td>
<td>Researchers</td>
<td>Perceptions of risk and commitment, Nexus, importation of research or commercial organisational cultures</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Couchman &amp; Beckett</td>
<td>Australia</td>
<td>Experiential Summary</td>
<td>One author from academia, one from industry</td>
<td>“Useable Knowledge”</td>
<td>Jargon, culture and perceived risk grouped as one of four cross-sector tensions</td>
</tr>
</tbody>
</table>
Research into other, non-cultural aspects of CRC organisations exists. The topics include: the satisfaction levels of PhD students working in or funded by Australian CRCs (K. Harman, 2002); practices for deciding ownership of intellectual property (Liyanage, 1995b); and the progress of CRCs towards forming “innovation clusters” (Liyanage, 1995a).

Just as studies of innovation have concentrated upon financial, intellectual property or legal perspectives, similarly, these structural factors are prominent in the Government model agreement for CRCs (Appendix 5). However, I propose that the transformation of formal collaborative agreements into productive and strategically effective relationships faces a communication challenge based upon ‘… the well-known difficulties of communicating between the diverse techno-cultures of scientists and engineers on one hand and business entrepreneurs …’ (Irwin et al., 1998, p. 468).

The activities of “boundary crossers” or “boundary spanners” or “linkers” are important in interdisciplinary collaboration (Irwin et al., 1998; T. Kuhn, 2002; Matthews & Frater, 2003; Tornatzky et al., 1999) and may aid commercialisation efforts in CRCs. A boundary crosser is an individual who can operate across a variety of cultures. In the context of a CRC, a boundary crosser will be skilled in operating in both research and commercial cultures. Investigation of the potential presence of boundary spanners within CRCs occurred as part of the exploration of boundary permeability of CRC subcultures.

To summarise, little attention appears to have been paid in the literature to inter-occupational factors or the potential presence of distinctive commercial or research subcultures influencing commercialisation activities within CRCs. The mixing of different organisational cultures was identified as a potential obstacle to the successful management of collaborative projects in New Zealand’s “Technology for Business Growth” (TBG) program (Davenport, Davies, & Grimes, 1999) in research investigating the development of trust. Consequently, identifying and assessing the influence of occupational subcultures in inter-disciplinary commercialisation activities appears to be a new area for research and will increase organisational knowledge of occupational subculture interactions and Australian CRCs. Therefore,
given the potential impact of CRC innovation outcomes on Australian society, and the level of public investment, this is an important area for research that has not yet been adequately addressed. This work addresses a gap in the organisational innovation literature by investigating the perceived impact of occupational subculture upon innovation from the perspective of people directly engaged in commercialisation activities.

Anecdotal evidence from a member of a company which had graduated from the CRC program, combined with the survey results from the 2003 CRC review shown in Table 4.2 suggest that there are issues which impact collaboration and they may be related to the existence and operation of occupational subcultures. Organisational cultural theories do not appear to have been extensively applied to CRCs or hybrid organisations engaged in commercialisation activities. While Turpin (Garrett-Jones et al., 2005; Turpin, 1999; Turpin & Deville, 1995; Turpin et al., 1996) and Liyanage (Liyanage, 1995a, 1995b; Liyanage & Mitchell, 1993) have been actively exploring the CRC organisational context, their work has focussed, respectively, on research community impacts and structural factors of CRC organisations. Hence, the thesis problem is that occupational subcultures may exist within CRCs and importantly, they may influence commercialisation outcomes.

4.5 Research Questions

Heavy demands upon the ability to learn can be expected in CRCs as they are inter-occupational and inter-organisational hybrids. Specifically, a new technology is being commercialised by a newly formed organisation, the people working in the organisation are working with members of occupational groups with whom they may have had little previous contact and new processes are being created for tasks such as manufacturing and decision-making. This means that non-routine work is being attempted in a new organisation, which lacks common or established processes. In such fluid environments, it is possible that each occupational group will use different occupational norms and beliefs about the right way of doing things as it attempts to make sense of the new environment. However, if there are large differences between
the belief systems of subcultures, tension and frustration are likely to feature in their interactions.

Informed by international economic pressures to increase national innovativeness, the national policy context and current knowledge related to organisational culture, hybrid organisations and innovation, this research will explore the following questions:

1. Do members of CRCs engaged in commercialisation recognise subcultures in their organisations and if so, how do they describe and identify the subcultures?

2. What can be determined about boundaries between subcultures in terms of shape, thickness and permeability in the context of commercialisation practices and outcomes?

3. How do CRC members perceive that occupational subcultures impact upon their work?

4. How can occupational boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?

Having reviewed and located the research in relation to existing studies of innovation, organisational and occupational culture and hybrid organisations, the following chapter justifies and describes the methodology, research design and execution of the study.
Chapter 5

Methodology

5.1 Aim and Organisation of the Methodology Chapter

This chapter justifies the selection of a qualitative case research methodology to investigate the thesis problem. This research adopts a qualitative methodology, using a case research framework to inductively create theory regarding interactions between occupational subcultures involved in commercialisation.

Qualitative research methods provide the systematic set of beliefs, together with accompanying methods to study constructed social realities (Lincoln & Guba, 1985). By case research I mean that while a case study framework is used to design and conduct the study, the research design diverges from case study prescriptions in two major areas. First, it does not commence with an a priori explanatory theory. Second, it uses thematic analysis to inductively build theory instead of deductively testing rival explanations (Hassard, 1991; Jones & Lyons, 2004; Ragin & Becker, 1992; Stake, 2000; Tellis, 1997; Yin, 1994, 2003, 2004).

The case research design, and links between the design and the research questions, are expounded in section 5.3, researcher bias and ethical considerations are reviewed in sections 5.4 and 5.5 and the procedures used to conduct, analyse, report and strengthen the quality of the research are contained in sections 5.6 to 5.8.
5.2 Justification for Adopting a Qualitative Paradigm

The complementarity of qualitative and quantitative paradigms is widely accepted, and the benefits of matching paradigm and methodology to the question investigated are well documented (D. R. Cooper & Schindler, 1998; Creswell, 1994; Grbich, 1999; Lincoln & Guba, 1985; Parkhe, 1993; Van Maanen, 1998). Accordingly the respective strengths and weaknesses of qualitative social science research are acknowledged and used in this research to provide an appropriate framework to explore complex, context dependent social interactions.

In evaluating a research paradigm to study occupations involved in commercialisation, the effects of communication and socio-cultural influences on the development of new technologies are important considerations (Kranzberg, 1997). Similarly, commercialisation involves teams (Steiner, 2000) consisting of members of specialised “communities of practice” (T. Kuhn, 2002) and is characterised by iterative communication (Rogers, 1996). These features necessarily influence methodological choices towards those that provide a flexible and holistic approach to social systems.

Organisational aspects of commercialisation have previously been studied through qualitative and quantitative methods applied to structural foci, such as the size, funding and age of the organisation (Davenport et al., 1999; D. O. Gray et al., 2001; Lehrer & Asakawa, 2004; Liyanage, 1995a; Liyanage & Mitchell, 1993). However, a large scale, multivariate analysis of industry partner renewal decisions in U.S. hybrid industry/university research centres (D. O. Gray et al., 2001) found that only “soft” factors related to social and administrative processes had some predictive value. None of the structural variables analysed, including staff size, the age of the centre and fiscal data were statistically significant predictors of industry partners’ decisions to renew their involvement in the centre (D. O. Gray et al., 2001).

Recent work, (Riedlinger et al., 2004; Siegel et al., 2004) examining commercialisation from the perspective of intermediaries, such as communication specialists and technology transfer officers, suggests that differences in the norms
and values of occupational subcultures may affect commercialisation outcomes. It is surprising that qualitative investigations of commercialisation drawing directly upon the experiences of members of research and commercial occupational subcultures (rather than reports of intermediaries), are rare in the literature. This research begins to address that gap by investigating interactions between individuals from research and commercial occupations working together on commercialisation projects in Australian Cooperative Research Centres (CRCs).

After reviewing the methodological literature and reflecting upon its application to my research questions, I determined that an holistic approach relying on interpretation was needed to address the paucity of published work regarding social factors at work in hybrid research organisations. Following the recommendations of Parkhe (1993), I have taken the approach that “soft” core concepts supporting voluntary cooperative relationships, such as joint ventures, are best identified through exploratory research, examining interactions and identifying themes, prior to attempting explanatory research.

A CRC consists of a range of individuals who are selected from a variety of professions and organisations. They work in a CRC that is aligned with a particular industry and located within a broad context of Australian society and Australian public research policy. The many situational factors that influence commercialisation and the complexity of the organisations explored in this study suit a flexible, semi-structured approach. There is little likelihood of identifying dependent and independent variables in advance, isolating and accurately measuring them in this setting. The methodological objective of this research is to provide a solid foundation that is flexible enough to permit holistic exploration, adaptation and inductive theory building.

As a result of choosing a social and interpretive perspective to complement the research context, the study’s paradigm is primarily qualitative, supplemented with data collected from pre-interview demographic surveys and published survey material such as the Evaluation of the Cooperative Research Centres Program (Department of Education Science and Training & Howard Partners, 2003) and the main report of the Science and Innovation Mapping Taskforce (2003).
The problem and questions investigated are time and situation specific and the foci are exploration and understanding of potentially unique situations, not prediction and control of general industry/academic partnerships. During this investigation, emic insights, referring to “insider” knowledge that is meaningful to members of a particular culture or subculture, were sought by interviewing managers, engineers and researchers about their experience of occupational subcultures in commercialisation.

The above discussion describes the relevance of a qualitative research perspective to the investigation of social systems, such as CRCs. Within the qualitative paradigm, social interactions between occupational subcultural groups can be investigated using a framework of organisational culture. The rationale for choosing organisational culture as the theoretical framework for the research is now explained.

5.2.1 Organisational Culture and Commercialisation.

As described in Chapter 1, an organisational culture framework was chosen as a “lens” to examine interactions in organisations engaged in commercialisation, from the other choices considered. For example, one alternative research lens is discourse analysis, which challenges the notion that stability and shared patterns are the norm in organisations and views power as dynamic and relational (Grant & Iedema, 2005). In particular, discourse analysis claims that cultural investigations fail to recognise the complexity of organisational life. This is a valid criticism of the popular integrationist perspective of organisational culture, but not of concomitant organisational cultural frames, such as the differentiation and fragmentation views discussed in Chapter 2 (Fitzgerald, 2002; J. Martin, 1992, 2002; Meyerson & Martin, 1987).

There are two main reasons for employing a cultural frame. First, the flexibility provided by the cultural frame, and the possibility that power relations may be unimportant in CRCs, advocate for organisational culture as the framework for the investigation. Second, and from a practical perspective, the idea of organisational culture was likely to be familiar to research participants, as an extension of concepts
of national culture and from their own organisational experiences. Conceptualising
the research in terms of occupational subcultures provided benefits in ease of
recruitment, speed of introduction of the research topic in the limited interview time
and, potentially, in the acceptance and use of research recommendations by CRC
members. The success of research is said to depend upon how well others understand
the concepts used (D. R. Cooper & Schindler, 1998). Framing the research in terms
of discourse analysis, semiotics or post-modern theoretical positions may have led
strongly positivist members of biomedical research communities to doubt its
applicability and jeopardise their participation. In contrast, notions of organisational
or national culture were readily accepted and may have facilitated recruitment and
execution of the research.

Having defended the use of a qualitative, exploratory design using an organisational
cultural framework as a lens through which to view occupational interactions in
CRCs in the above section and in Chapter 1, the following section reviews the
methodology used to operationalise the research questions and evaluates the research
design.

## 5.3 Linking Research Questions to the Research Framework

The research questions, informed by the literature review, explored whether
occupational subcultures exist within CRCs or impact commercialisation outcomes.
Specifically, I examined the potential existence and influence of occupational
subcultures in commercialisation by exploring if members of CRCs engaged in
commercialisation recognised subcultures in their organisations, and if so, how they
described and identified the subcultures, the boundaries between subcultures, their
impact and how to best manage subcultural boundaries. The research paradigm
adopted for this research can be summarised as qualitative, collecting direct
observations and indirect evidence gathered through semi-structured retrospective
and longitudinal interviews and permitting themes to emerge from the data.
Case research is employed because its flexibility suits the complexity of the research context (Benbasat, Goldstein, & Mead, 1987; Bonoma, 1985; Myers, 1997; Parkhe, 1993). Case research is a well accepted form of organisational enquiry (Van Maanen, 1998) and has been used to explore issues related to organisational values and change. For example, Biggart (1998) examined the US Post Office, contrasting groups within the organisation holding profit or service based ideologies. Longitudinal, single site studies have been combined with multiple retrospective case studies of dynamic technology transfer processes to balance the strengths and weaknesses of longitudinal and retrospective studies (Leonard-Barton, 1990). A case study using retrospective and longitudinal interviews to understand the changing role of an organisation (Maniha & Perrow, 1998) is cited as an exemplar of qualitative research in the Administrative Science Quarterly’s collection of organisational studies (Van Maanen, 1998). Therefore case research has a methodological pedigree that supports its application to the current research questions.

The research framework involved informants describing examples of cultural forms experienced within their working environment. Individuals from organisations that had been part of the CRC program were interviewed once about their past experiences. Members of current CRCs were interviewed three times to explore changes in inter-occupational relations over time and to provide the opportunity for reflection between meetings.

5.3.1 Rationale for the use of a Case Research Framework

The methodological literature recommends case studies for in-depth examination of bounded systems based upon the lived experience of participants (McCaslin & Wilson, 2003). Single case studies are generally based on intrinsic interest while multiple cases may be used in an instrumental, collective way to assist in understanding an issue (Abbott, 1992; Stake, 2000). The strengths of a case research strategy include:
**Flexibility:** Case research allows the research context to guide the design as the study progresses and supports asking multiple research questions, or questions with a number of previously unexplored dimensions (Jones & Lyons, 2004; Parkhe, 1993).

**Understanding of meaning:** Underlying actions can be queried in their natural context rather than forcing a split into dependent and independent variables (Yin, 1994).

**Setting:** Case research permits the exploration of issues and context where boundaries and definitions are unclear (Yin, 1994).

**Multiple-sources:** Case research is well suited to situations in which there are more variables of interest than data points (Yin, 1994).

**Multiple Sources of Evidence:** This allows for cross-checking data and interpretations (Lincoln & Guba, 1985; Stake, 2000; Yin, 1994).

To avoid controversy the term “case research” has been adopted for this study. The words “case study” have been used interchangeably for design, method and teaching tool, creating ambiguity about what may and may not be classified as a case study (Creswell, 1998; Jones & Lyons, 2004; Ragin & Becker, 1992; Stake, 2000). The value of standardised reporting formats and a priori theory are also contested (Lincoln & Guba, 1985; Tellis, 1997). Eisenhardt (1989, p. 536) is clear in her admonitions against a priori theory in case study research “… most importantly, theory-building research is done as close as possible to the ideal of no theory under consideration and no hypotheses to test." Yin (1994, p.49) states his arguments for a priori theory with equal certainty " ... the initial step in designing the study must consist of theory development ...”. Furthermore, a case as a unit of analysis, can be viewed as a choice of what is to be studied rather than a methodology (Stake, 2000). Terms such as case research and case method have been used previously to describe variants of case study methods (Benbasat et al., 1987; Bonoma, 1985; Halinen & Tomroos, 2005).
To permit holistic, in-depth exploration of the research questions case research was selected as the methodological framework, or comprehensive research strategy by which data was gathered. In this thesis, case research is used as a systematic way of collecting and analysing data from bounded entities, capturing events in a framework within a particular environment. The methodology is broadly based upon that of the case study, but differs from prescriptions for case studies in the absence of a priori theory and the use of thematic analysis.

CRC organisations were identified as the “cases” for the study; purposive, integrated, bounded systems, with working parts and patterned behaviour (Stake, 2000). Case research methodology then provided the framework to investigate the possible presence of occupational subcultures within Australian CRCs, and their potential impact upon commercialisation outcomes.

### 5.4 Limitations of the Methodology

The quality of qualitative research is assessed by its credibility, accuracy and trustworthiness (Creswell, 1998; Lincoln & Guba, 1985). A limitation of interpretive schema using interviews to explore informants’ perceptions is reliance upon the insightfulness, memory and testimony of informants. Using multiple informants from each of four separate CRCs operating in two industries, and providing a summary of the research results to informants for comment were the main actions taken to address this limitation. Case research provides weak levels of generalisation and reliability. This is no different to other forms of qualitative research, as qualitative research is subject to the reality that observed patterns are time bound and context bound, and may not be sustained beyond the period of study.

However, issues of generalisability can be addressed by arguing that case studies are concerned with analytical generalisation (to develop theories) and not statistical generalisation to a larger population (Yin, 1994, 2003, 2004). The aim of "transferability" of findings from one context to another is considered preferable to notions of generalisability (Lincoln & Guba, 1985). Generally, transferability is achieved through detailed descriptions of the methods used in a study and may be
enhanced by the use of triangulation strategies to cross-check data and interpretations (Lincoln & Guba, 1985). Parkhe (1993) agrees that the dependability and credibility of case research findings can be raised through good research design and the use of a protocol.

The trustworthiness of qualitative research can be strengthened,

“… there are techniques that naturalists can employ that, while they fall short of guaranteeing balance and fairness, can nevertheless provide a system of useful checks and balances.”


The specific techniques used to enhance the quality of this research include:

**Member checks:** performed by providing interview transcripts and later, a working paper to interviewees (reproduced in Appendix 6), for correction, verification and the opportunity to challenge or confirm findings.

**Use of a research protocol and reflexive memos** to ensure that the findings of interviews were captured and used in a systematic way between organisations, between participants and over time.

**Debriefings by peers:** by systematically talking through research experiences, findings and decisions with my thesis supervisors.

**Cross-checking data and interpretations: through prolonged engagement** (Lincoln & Guba, 1985; Parkhe, 1993; Stake, 2000; Yin, 1994) with the two currently funded CRCs and through use of constant comparative methods (Boeije, 2000). While it may have been desirable to extend the schedule of longitudinal interviews, this was not feasible given the time constraints for completion of PhD research in Australia.

Triangulating the qualitative interview data with information from quantitative measures including demographic information and published government surveys to improve the construct validity of the research (Yin, 1994, p. 93), that patterns observed in reality correspond with the theory developed), and
The use of introspective, reflective journals: "… that display the investigator's mind processes, philosophical position and bases of decisions about the inquiry." (Lincoln & Guba, 1985, p. 109) to identify and manage researcher bias.

Conducting trial interviews with individuals currently engaged in commercialisation projects: to obtain an ‘insider’ perspective of central concepts for the research and foreshadow issues to inform potential interview questions.

Beyond these actions, the collection of data from more than one individual in each organisation increases confidence in the measures of the constructs. In addition to its general acceptance and flexibility (Creswell, 1994; Van Maanen, 1998), case research permits the identification of relationships that might not be treated as operationalised variables if structure is imposed before research commences and can flexibly accommodate emerging findings. Hence, case study research provides an appropriate framework for the collection and analysis of data, and by exploring individual CRCs and comparing them to other CRCs, permit insight into the interactions of occupational groups in natural settings.

5.4.1 The Researcher’s Biases

My personal, educational and managerial experiences will have influenced my interpretation of the data. However, critical self-reflection immediately after the interviews, while typing the transcripts and during analysis assisted in identifying and balancing the impact of researcher bias. Insights from my work experience led to greater variety and more balance in the inductive insights incorporated into the reflexive journal, and consequently contributed to the trustworthiness of the work (Lincoln & Guba, 1985).

The use of reflection to identify potential preconceptions has reduced the impact of my personal frames, and provided opportunities to create shared understandings with members of both research and commercial communities. Providing the interviewees with transcripts of their interviews and a working paper containing preliminary
research results provided opportunities to support or challenge of the conclusions of the research, and further reduced the impact of my personal frames.

5.5 Ethical Considerations

The University of Western Sydney’s Ethics Committee approved the study prior to commencement. All participants gave written consent and were provided with an information sheet stating the purpose of the study and participants’ rights, including the right to withdraw from the study (Appendix 7). Participants were informed that the research was conducted independently of Government agencies and were thanked for their participation at the end of each interview.

Anonymity of participants is assured by protecting and maintaining the raw data, and removing all potential identifiers from any published reports. No identifiers were used on the transcriptions, apart from the organisation pseudonym and the occupation of the interviewee. Recordings and transcriptions will be kept secure on the premises of the University of Western Sydney for a period of 5 years.

5.6 Research Methods

As previously acknowledged, the case research methodology adopted for this research is a modification of the framework recommended by Yin (1994; 2003; 2004) and broadly follows his four stage framework. The four stages, covered in depth in the remainder of this chapter, are: designing the research, conducting the research (procedures), analysing the evidence and developing conclusions, recommendations and implications based on the evidence.
5.6.1 **Stage One: Designing the Research**

Following Yin’s (1994) model, key design activities included developing and reviewing a research protocol linking the research questions to a plan for data collection, and identifying what constitute the “cases” for study.

According to Yin (1994), a protocol is essential for multiple case studies as the rules and procedures contained in the protocol can improve consistency in conducting the research, maintain investigator focus on the research questions and assist in replication of the study. The protocol used in this research (Appendix 8) includes an overview of the project, statement of the thesis problem and a question guide for each of the research issues deemed suitable for use in semi-structured interviews.

A research design logically connects the empirical data to a study's initial questions and, ultimately, to its conclusions (Yin, 1994). The research questions concern matters of “what” and “how” consistent with interpretive studies and as such do not and need not have a predetermined proposition (Tellis, 1997). In this investigation, research questions were formulated prior to formal recruitment of cases, but theoretical propositions were not, in order to minimise bias arising from theoretical preconceptions developed before actual contact with the context of interest.

5.6.1.1 **Multiple Organisation Research Design**

The cases, or bounded systems, studied in this research were four CRC organisations. The material from the four CRCs was supplemented by observations and with interviews with individuals associated with the Australian CRC model of commercialisation. The link between the choice of case and the research questions is a key factor in case research (Jones & Lyons, 2004; Stake, 2000; Tellis, 1997; Yin, 1994). Selection of a “system of action” is recommended in preference to an individual or group, in order to permit understanding of the case as an integrated system with patterned behaviour and working parts (Stake, 2000).

In this research the questions pertain to occupational subcultures. Logically, subcultures are expressed within organisational cultures. Therefore CRCs provided
the organisational boundaries for the research that permitted exploration of interactions between occupations engaged in commercialisation.

Each of the four CRCs, selected on the basis of age and industry, constituted a bounded system for study in its own right and was part of a set of collective cases. Stake (2000) has commented that, while permitting less inherent interest in each organisation, collective case studies do provide the opportunity to investigate, and gain insight into an issue of interest. “A researcher may jointly study a number of cases in order to investigate a phenomenon, population or general condition” (Stake, 2000, p. 437). Also, the choice of four organisations reduced the possibility of patterns stemming from factors unique to one organisation mistakenly being viewed as representative of interactions between research and commercial occupations. For example, the idiosyncratic actions of a particular individual would not be likely to appear in all four CRCs.

Two organisations were recruited from listings of CRCs in each of the Information Technology and Communications (ICT) sector and the Biomedical sector. These sectors were targeted in the expectation that the CRC organisations would be producing products and services for sale. Comprehensive description of recruitment procedures is contained in Appendix 9. In each industry sector, one CRC was currently receiving funding and one had graduated from the CRC program and was no longer receiving funding. In matching the CRCs by industry, and by current or graduate funding status, the opportunity to observe similar results across one or both dimensions (literal replication) or opposite results (theoretical replication) is incorporated into the design (Audet & D'Amboise, 2001). In addition, groupings of occupational members may turn out to be sufficiently distinctive to be considered embedded cases within the CRC organisations (Yin, 1994). Figure 5.1 illustrates the multiple case research design chosen for the study.
**5.6.1.2 Trial Interviews**

Recommendations for “best practice” cross-cultural research (Schaffer & Riordan, 2003) can be applied to the development of questions for qualitative studies. A combined emic-etic (insider-outsider) approach was used for question design. Trial interviews about the experience and perception of interactions between researchers and business personnel in commercialisation were held with a scientist, a manager and an engineer to accommodate potential differences in occupational groups (selection and implementation details are contained in Appendix 9). The interviewees volunteered examples of cultural values and assumptions they had experienced, such as tension between motivations toward knowledge production or money making, and other areas likely to be potential boundary constructs. The insights gained from the trial interviews were used to develop potential questions to operationalise research questions concerning occupational subcultures, cultural forms, subcultural boundaries, the potential impact of subcultures and ways of managing boundaries to improve commercialisation processes and outcomes. These questions were then reviewed by a panel of experienced supervisors, modified and included in the interview protocol, contained in Appendix 8.

The rationale for using semi-structured interviews was that their flexibility permits collection of the data needed to begin to understand the lived experience of CRC members from different occupational groups and to inductively develop theory.

QSR N-Vivo® software was used to aid the coding and organisation of interviews and observations, facilitating the interpretation process. The process of thematic analysis is described in section 5.7.1, and the coding structure generated from the interviews is contained in Appendix 10.
To summarise the research design; a case research framework was selected to support flexible exploration of inter-occupational interactions in commercialisation. The bounded system selected for analysis, consistent with the thrust of the research questions, was the CRC organisation. The procedural steps needed to replicate the study are summarised in the following section. Full details of time boundaries, recruitment processes, delimitations and interview schedules for each CRC are contained in Appendices 4, 9 and 15.

5.6.2 Stage Two: Conducting the Research

Having explained the rationale for the research design, the next section describes recruitment, sources of information, collection of demographic information, and data collection through conducting semi-structured interviews.

5.6.2.1 Recruitment and Sources of Information

Due to the qualitative nature of the work, the intensive nature of interviewing, and the small number of individuals working in each CRC it was neither desirable nor possible to use the probability sampling strategies advocated for large quantitative studies (D. R. Cooper & Schindler, 1998). Purposive sampling, (sampling with the intent of the study in mind) was accomplished through an emergent sampling design, including continuous focusing of the sample and selection to the point of redundancy (Lincoln & Guba, 1985).

Direct approaches to the executive managers of existing CRCs or CRC spin-offs, the Australian Department of Education, Science and Technology and the Australian CRC Association produced three lists:

1. CRCs in formation (funding announced in 2004)
2. Currently funded CRCs and
3. Companies created from CRCs, known as Direct Research Spin-Offs, (DRSOs).
CRCs intending to sell research outcomes were targeted for recruitment in preference to environmental or “public good” CRCs in the expectation that a strong commercial orientation would be held by the CRC management.

An e-mail was sent to the executive management contact from the list of CRCs in formation, followed up with a phone call. The invitation to participate in the research is contained in Appendix 11. The same invitation was printed on University of Western Sydney letterhead and mailed to the executive manager of the CRC organisations on the currently funded and DRSO lists. More than four organisations fitting the industry criterion responded to the direct mail letter. Telephone contact was made to select four CRCs fitting the research design and arrange times to conduct individual interviews. In exchange for their participation organisations were offered a summary of the research results and recommendations. This was provided in the form of a working paper.

The four organisations recruited to be cases in the study will be identified by the pseudonyms IT Current, Biomedical Current, IT Graduate and Biomedical Graduate.

Purposive sampling was used to recruit all individuals interviewed. The sampling procedure is described in full in Appendix 9.

Seventy organisations are currently funded by the CRC program. The information and communications technology and medical science categories both have nine CRCs (Association, 2006). Two CRCs, or twelve percent of the information and communications technology and medical science CRCs, were explored as cases.

A total of thirty-six interviews were conducted with twenty individuals. More interviews were conducted than had been originally planned due to the impact of multiple, longitudinal interviews. The two CRCs currently in receipt of funding were of similar size and had between 40 and 50 full time equivalent members. It is estimated that approximately 13% of the IT Current and 7% of the Biomed Current members were interviewed. It is very difficult to provide estimates for the ITGraduate and BiomedGraduate organisations as they were no longer reported in CRC Program statistics. Also, the size of the Graduate cases was reported to have
fluctuated as research groups were formed, developed a technology and were then spun off as independent businesses.

The final number of informants was influenced by assessments of theme clarity and whether new information was being collected. The sampling choices reflect thought processes and decisions that changed once interviewing started based on theoretical sampling decisions. However, care was taken to ensure equal coverage. Table 5.1 below shows a summary of the number, gender and occupation of interviewees.

Table 5.1: Interview Summary showing Gender and Occupation of Informants

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Researcher</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Engineer</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Manager</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18</td>
<td>2</td>
<td>20</td>
</tr>
</tbody>
</table>

*Source: Demographic questionnaires completed prior to interview*

The sample was strongly biased towards male respondents, with only two interviews out of twenty conducted with women. However, this is consistent with male dominance in engineering and technical occupations in Australia and reflects the population working in commercialisation.

The time elapsed since each case first received CRC funding was two years for the IT Current CRC, nine years for the Biomedical Current CRC, and over fourteen years for both the IT Graduate and Biomedical Graduate CRCs. Consequently the sample provided a good range of organisational maturity.

Demographic information about occupational membership and ethnicity was collected before interviews commenced to assist in identifying factors likely to influence occupational sub-culture formation in a multicultural society such as Australia. Secondment status, education and employment histories were also collected as the trial interviewees had suggested commercialisation outcomes can be
influenced by differences in these characteristics. The demographic questionnaire and collected demographic data are contained in Appendices 12, and 13.

### 5.6.2.2 Semi-Structured Interviews

Semi-structured interviews formed the study’s foundation and provided the majority of insights into the topic of occupational subcultures in commercialisation. Interviews varied in their tone and structure. Participants were informed of the research topic in advance but were not given questions or topic guides. The questions used were selected from the research protocol prior to the interview, and supplemented by new questions based upon themes revealed by completed interviews. This approach allowed the interviews to remain conversational while collecting comprehensive responses in a systematic and flexible way.

My primary thesis supervisor participated in the first interview in order to provide feedback on questions and technique. As I conducted all other interviews alone, there was no need to coordinate and standardise interview processes among a group of researchers. Therefore, the protocol does not describe field procedures.

Due to geographic factors, ten interviews with members of current CRCs were conducted by ‘phone instead of, or in conjunction with one face to face interview. However, the data acquired by ‘phone was equally rich and the interviews were similar in length, tone and conversational content to those conducted face to face.

### 5.6.2.3 Data Collection

Interviews were of an iterative nature, meaning that if further information or confirmation of data was required, the researcher returned to the interviewee. Four participants were contacted by e-mail after completion of their interview schedule with a request for further information. Three responded and one did not.

Interview length varied between thirty minutes and two and a half hours. After completion of consent forms, interviews were recorded, transcribed verbatim by the researcher and e-mailed to informants for review, except for two informants who were between jobs and did not provide email addresses. This member checking
allowed participants to check the accuracy and the anonymity of the transcription and add comments after the end of the interview; this contributes to the credibility of the findings.

Complete demographic data for the twenty interviewees is displayed and summarised in Appendix 13.

Qualitative research is both context and time bound. As a result of purposive sampling all interviews were completed between July 23, 2004 and Dec 19, 2005, in the shortest timeframe possible. The process of reflection started during interviews and continued through transcription. The researcher used a reflective journal to note emerging patterns and ideas (an excerpt is provided in Appendix 14).

Tables summarising the time and location of all interviews are contained in Appendix 4.

5.6.2.4 Nature and Tone of Interviews

While the purposive sampling techniques resulted in some informants knowing who had nominated them in the IT Current, IT Graduate and Biomedical Current CRCs, informants in the Biomedical Graduate CRC did not know who was interviewed. While it was easier to set up meetings in the two current CRCs, where the executive manager had made a central commitment to participate and had nominated potential interviewees, there were no apparent differences in the participants’ willingness to become involved. On one occasion, the manager first nominated by the CRC executive referred me to another individual, who referred me to yet another. However, the third individual, a researcher, was heavily involved in CRC project work and was better able to discuss inter-occupational experiences in CRCs. Consequently, snowball sampling (Brace-Govan, 2004; D. R. Cooper & Schindler, 1998) where interviewees nominated others who had worked in the organisation, resulted in informants who were known to each other and may have shared similar views. However, the recruitment plan resulted in the participation of individuals in the occupations of interest, in managerial and non-managerial positions and in public and private research, government and commercial organisations. They knew that the
research would protect their anonymity and did not appear inhibited in discussing the topic.

All participants willingly described a variety of experiences and interpretations of the events in their working life and did not seem concerned when members of their network knew of their participation. With only two exceptions, who kept strictly to time, the interviewees all spoke for longer than the time requested, suggesting the topic was of interest and significance. Several repeatedly described the topic of the research as ‘very important’. With one exception, who occasionally lapsed into “public relations” descriptions of the CRC’s purpose in the first of his three interviews, the interviewees did not appear to be giving rehearsed responses to the questions.

The participants were highly educated and articulate. Several occupied high status, senior positions in research and business organisations, casually referred to their interactions with politicians, (signalling membership of influential networks) and were charismatic. One challenge of interviewing elite subjects is to avoid the interviewee dominating the interview and directing it away from the research questions (Welch, Marschan-Piekkari, Penttinen, & Tahvanainen, 1999). The semi-structured interviews were kept on topic by positioning them as an opportunity to discuss provocative views from theorists (or from earlier informants, presented anonymously, for example, ‘A scientist I interviewed last week said…”) and asking the current interviewee to respond with their views. In addition, several interviews took on therapeutic overtones as some individuals used the opportunity as a confidential outlet to discuss frustrations, disappointments and fears for the long-term survival of their work and employment. For instance, the following interchange illustrates emotional involvement:

*Interviewer: How do you think university or CSIRO researchers view people in commercial occupations when they have to work together to commercialise…*

*Manager (interrupting): Oh filthy. Dirty, dirty, dirty. Despicable. Anything that comes between a researcher and a pot of money is to be denigrated and pushed aside. I'm feeling, you've caught me in a very bad moment.*
Similarly, from the perspective of a researcher from the same organisation:

*For me that was quite a significant impact on my life because just emotionally, that was something I had worked on for a number of years and suddenly I was taken out of this and it was not really fair I thought, and not really based on something on my value as a founder and as a scientist ... I could have avoided the conflict with this person but the methods that he used were just inappropriate and I couldn’t sustain insults and things like that and I just had to respond. Although maybe if I had a different culture and ... was not that focused on the company succeeding, if I was focused more on keeping my position then maybe I would behave differently.*

The exploration of occupational subcultures in commercialisation obviously raised unpleasant emotions and required re-visiting painful incidents for several, but not all participants. On these occasions, I hoped that talking to me helped the interviewees in providing an opportunity to express the emotions to an independent third party, and have their experience put into a larger context of inter-occupational difference rather than personal enmity. Also, two of the safeguards offered to participants as part of the ethics approval for the research were the opportunity to withdraw from the research at any time, and provision of the transcript of their interview(s) with an offer to remove any sections. I conclude that re-visiting of emotionally difficult incidents was not overly disturbing to the participants as no one withdrew from the research or requested the deletion of transcript sections.

### 5.6.3 Stage Three: Analysing the Data

The two stages adopted from Yin (1994): the planning or design stage and the “doing” or procedural stage have now been addressed. Stage three concerns analysis of the interview data, and is now addressed.

The thesis problem concerns the potential for occupational subcultures to exist within CRCs, and on impact commercialisation outcomes. The research design operationalised organisational theories of culture and subcultures, through examination of organisations composed of commercial and academic personnel engaged in commercialisation. Data in the form of transcribed interviews, observations and documentation was collected. The focus of data analysis was to
understand and find meaning in the reported commercialisation experiences of interviewees from commercial and research occupations.

Combining ways of recognising, recording and exploring ideas is central to inductive, interpretive research and the steps taken to examine data can change during the iterative stages of analysis (Bazeley & Richards, 2000; Lincoln & Guba, 1985). Thematic analysis (Aronson, 1994; McMurray, Pace, & Scott, 2004) combined with iterative comparative processes (Boeije, 2000) and cross-case comparisons (Audet & D'Amboise, 2001) were used to ensure a thorough analysis.

The use of thematic analysis represents a departure from case study traditions of analysis. Yin (1994) specifies pattern matching (describing two potential patterns prior to conducting the research, and then showing the data matches one better than the other), explanation building (stipulating causal links and seeking plausible, rival explanations) or time series analyses (tracking changes over time in variables selected before research commences) as the main modes of analysis for case studies. Thematic analysis was chosen to match the inductive nature of this research and is appropriate given the absence of a priori theory.

5.6.3.1 Thematic Analysis

Comparison plays a central role in inductive theory generation, in supporting the creation of categories, coding schemes and finding connections in the data. Comparison is viewed as a creative process, based on the interplay between data and researcher in gathering and analysing data (Eisenhardt, 1989). Classification is achieved by comparing objects and events to identify similarities and differences, and is then followed by a theoretical comparison between categories.

Comparisons within and across-cases, and within and across occupational groups, were planned to aid in the development of stable categories, the identification of patterns in the data and answers to the research questions. Each interview was read as a whole, analysed and then compared to others to uncover commonalities and differences.
Themes are defined as “… higher-level abstractions inferred from their connection to a unique structure or pattern in the content” (D. R. Cooper & Schindler, 1998, p. 417) which can explain aspects of human behaviour and that draw attention to the explicit or implied attitudes of a person, group or culture (McMurray et al., 2004). Attention has been directed to two types of themes; statements of meaning that run through most or all of the data and those themes may not occur frequently in the data but carry a strong or emotional impact (M. Ely, Anzul, Friedman, Garner, & Steinmetz, 1991). The interviews revealed a number of core themes which reflected the participants’ experience and their world, consistent with the interpretive philosophy of the research. Using a reflective, iterative process, moving between what was revealed by the interview transcripts and relating it to the literature, the data was interrogated to explore relationships between and within the themes. The coding scheme used to capture the intuitive themes emerging from the data is contained in Appendix 10.

Themes emerging from the semi-structured interviews were compared to all data sources and each other to permit cross-checking of data, allowing differences and connections between themes to be identified. This was done to provide a clear picture of the interviewees’ experience of the social reality of commercialisation and to address the research questions concerning occupational subcultures, boundaries, boundary management and perceptions of the potential impact of occupational subcultures. Interviews were linked to the demographic data for each individual. Following the seven stage thematic analysis process advocated for semi-structured data gathered from different individuals (McMurray et al., 2004) the following steps were then taken;

**Step 1.** Interviews were coded to systematically transform the raw data into “codes” which permit precise description of relevant content characteristics. This was done by carefully reading, then reflecting upon the meaning of each passage and assigning a core word or phrase (code), to describe, and later define, the underlying concept. NVivo software was used to assist in the allocation and organisation of the codes. This process is also known as unitising (Lincoln & Guba, 1985).
Step 2. Material answering the four research questions was grouped together based upon the coding performed in step 1.

Step 3. The interview material was sorted according to emerging, provisional categories, on the basis of “look-alike” characteristics (Lincoln & Guba, 1985). All passages related to a particular concept were collected into a category. The categories included inferences regarding cultural belief systems as well as physical manifestations.

Step 4. Themes, and examples of themes were identified by looking for similarities in statements and accumulating all statements that appear to deal with similar ideas.

Step 5. Themes were stated clearly with illustrative examples chosen to demonstrate how the theme was identified and support the conceptual or abstract themes.

Step 6. When all responses from all interviewees had been reviewed for themes, similarities and differences were sought based upon comparisons between different occupational and CRC groupings.

Step 7. The process of analysing the data and the resulting theme and patterns identified were reported, reflecting both interviewee responses and interviewer interpretations.

5.6.3.2 Progressive Comparative Method

Progressive Comparative Method (Fitzgerald, 2002; Fitzgerald & Hayes, 2006), an adaptation of Constant Comparative Method (Glaser & Strauss, 1967) was used in the analysis. Boeije (2000) developed a five-step procedure for constant comparison from her own experience with qualitative analysis of data. Fitzgerald (2002) modified Boeije’s stepped process in order to enhance its comparative focus, as follows:

Step one: Comparison within single in-depth interview
Step two: Comparison between interviews within the same group
Step three: Comparison of interviews from different groups
Step four: Comparison of different groups

The analysis consists of two activities, namely, *dividing* and *linking*. ‘Dividing’ emphasises the separate themes that emerge during interviews and focuses on an individual ordering process relevant to the research questions. ‘Linking’ accentuates the content and richness of the data and attempts to interpret the parts as a whole and connect the pieces together. Further analysis follows this procedure to help systematise the analysis process. The term “progressive” rather than “constant” is used as the latter implies a continual process of comparison, whereas the actual process is more discontinuous, as each phase of comparison builds on previous comparisons of the research data. These progressive comparisons, summarised in general form in table 5.2, form the foundation of the thematic analyses reported in Chapters 6, 7 and 8.
Table 5.2  Template for Progressive Comparison Method

<table>
<thead>
<tr>
<th>Type of comparison</th>
<th>Data used</th>
<th>Analysis activity</th>
<th>Questions asked</th>
<th>Results</th>
</tr>
</thead>
</table>
| 1. Within one interview | One interview | DIVIDING Open coding. Summarising of core of interview. | What is the main message?  
How are different fragments related?  
Are there contradictions? | Summary of interview concepts  
Provisional codes |
| 2. Between single interviews of same group. | More than one interview. Theoretical sampling until saturated | DIVIDING and LINKING Axial coding. Formulating criteria for comparing interviews. Formulating hypotheses. Development of typology. | Is X talking about the same as Y?  
What do the interviews reveal about the concept?  
What combinations of concepts occur?  
What interpretation exists for this?  
What are the similarities and differences between interviews X, Y, and Z?  
What criteria underlie this comparison? | Expansion of codes.  
Development of concepts.  
Criteria for comparing interviews.  
Typology (clusters of interviews) |
| 3. Between single interview(s) different group (s) | More than one interview. Theoretical sampling until saturated | DIVIDING and LINKING Selecting themes from open coding that concern the relationship. Summarising the relationship. | How can the relationship be typified from different perspectives?  
What codes are used to cover the core themes?  
Is there contradiction/agreement between them?  
What are the central issues and how are they resolved? | Conceptional profile of relationships.  
Inventory of central issues. |
| 4. Between multiple interviews of different groups | Interviews with different groups | LINKING Data sources, triangulation. Summarising the relationships. Fitting criteria to compare groups. Development of a model. | What are the typical differences between group X and group Y?  
What are the possible reasons for this?  
On which criteria can groups be compared?  
What are the relationship issues under these circumstances?  
What patterns exist?  
What is NOT said? | Clusters of relationships, commonalities and differences between groups. |
The above sections described in detail the iterative, interpretive approach employed in the thematic analysis and the use of Progressive Comparative Methodology to structure the comparisons across CRC organisations and occupational groups. The next section addresses the reporting format selected for the study.

5.6.4 Stage Four: Reporting the Research

While Yin (1994) proposes that the reporting format be planned at the start, the research protocol for this study does not contain an outline and format for the report. This is because thesis format conventions, the uncertain nature of research outcomes and the inability of any one report format to accommodate the unique nature of each case (Tellis, 1997) work against the adoption of a standard case study reporting format.

However, consistent with the instrumental research design, examining multiple organisations to consider occupational cultural questions, the report was planned to primarily focus on the participants’ experience of these matters. Thick description of each organisation and its context would not be provided. Instead, the complexity of the CRC organisation model and key themes reported by interviewees would be explored. These themes would then be considered in depth, using confirming and disconfirming material from the interviews and other data sources.

Yin (1994) identifies several possible structures for case reports including: linear-analytic, comparative, chronological reporting, allowing the sequence of chapters or sections to follow a theory building logic and "suspense" structures presenting answers and outcomes in the first chapter. During the process of thematic analysis it was decided to use the standard linear-analytic form, covering the issue studied, literature review, methods used, findings from data collected and analysed, conclusions and implications of findings. This decision was made because the linear-analytic style is a tested and well accepted format for reporting the preparation, planning, execution, results and conclusions of thesis research. The report ends with the reminder that the report represents an individual interpretation of complex, time-bound incidents.
In summary, four temporary, hybrid organisations composed of research and commercial personnel engaged in commercialisation activities were recruited and individuals from managerial, research and engineering roles were interviewed. A total of thirty-six semi-structured interviews were conducted with twenty individuals. Two organisations were aligned with the biomedical field and two with the Information Technology and Communications sector. The organisations’ maturity ranged from newly formed (two years) to publicly listed companies (more than fourteen years). The interviewees’ experiences and perceptions of differing subcultural norms were recorded and transcribed verbatim. QSR N-Vivo® software was used to aid detailed coding and analysis of the collected research material, facilitating the interpretation process. Thematic analysis and Progressive Comparative Method were used to systematically explore the content themes within, and between organisations and occupational groups.
Chapter 6

Results: Occupational Subcultural Boundaries

6.1 Introduction to Findings, Analysis and Discussion

This chapter starts the analysis of themes emerging from the interviews and applies the findings to the research questions, with reference to existing theory. The data collected through execution of the research plan described in Chapter 5 is presented through the use of tables, direct quotations and thematic analysis, using Progressive Comparative Methodology, (Fitzgerald, 2002; Fitzgerald & Hayes, 2006). In Chapter 7, occupation-specific argumentation as a manifestation of occupational subcultural difference is analysed in depth. The finding of occupation specific argumentation has not been previously commented upon in either innovation or organisational cultural literatures (Hayes & Fitzgerald, 2006; Hayes & Fitzgerald, 2007) and represents a contribution to knowledge. Chapter 8 addresses the last research question: how to manage occupational boundaries to improve organisational processes and outcomes in Australian CRCs. Finally, Chapter 9 presents areas for future research and the implications of the findings for organisational cultural, innovation and management theory and practice.

Analysis of the interviews reveals patterns of consistent differentiation between two broad occupational commercial and research subcultures: Description of the process of identification and classification of the two subcultural groupings is located in sections 6.3 and 6.5 of this chapter. Further progressive comparative analysis of the interviews led to the development of content themes. The organisational cultural boundaries
between the two groups are marked by, but not limited to, language norms, approach to work activities, motivations, reward systems, temporal perceptions and assumptions regarding which work activities justify effort and deserve priority. Application of extant theories of organisational culture, innovation and hybrid organisations occurs within the two results chapters as part of an integrated treatment of the thesis questions. For example, discussion of the literature regarding argumentation and occupation occurs during presentation of the results that relate to the discovery of occupational argumentation repertoires as a barrier to commercialisation.

The presentation of thesis results commences with a summary of recruitment results in the form of descriptive data about the interviewees and the four organisations. This description provides details pertinent to the assessment of the research, whilst maintaining individual and organisational anonymity. Presentation of summary data rather than thick description is consistent with conventions for collective case research reports (Derthick, 2004; Yin, 2004). A brief description of the four CRCs, informants and the interview data collected are contained in Appendix 15.

Comparisons between the CRCs reveal that the interviews conducted early in the research, primarily in the IT Graduate and Biomedical Graduate organisations, focus on the first two research questions: the existence of occupational subcultures, their manifestations and the extent of the boundaries. The later interviews, with IT Current and Biomedical Current informants, confirmed the findings of the first interviews and continued to explore boundary management, organisational and occupational jurisdiction of CRC members and argumentation as occupational boundary constructs.

As is the case with most qualitative research, it is advisable to choose a small number of research phenomena for focus to permit indepth investigation of a particular phenomenon (Stake, 2000). In ordering the findings of my research, I have found it helpful to use a metaphor to describe the research setting and the selection of three occupational cultural artefacts for intensive examination. I metaphorically compare CRCs to grafted fruit trees. They are unique by virtue of industry sector, member
organisations and individual participants, but tend to have research “rootstock”. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is the largest single participant in Australian CRCs, (Commonwealth Scientific and Industrial Research Organisation, 2006), and researchers outnumber commercial personnel (Liyanage & Mitchell, 1993). The two parent plants grown in isolation produce different fruit, knowledge and money, but government policy interventions act as grafting tape to join the plants together. In 2006 there were 71 such grafted trees (Department of Education Science and Training, 2006). I have looked at four, and chosen three themes that arose in interviews with the participants in this collective study of complex organisations using qualitative research. The themes selected for intensive reporting are: occupational work approaches of exploration and exploitation; post-graduate education as a boundary construct; and inter-occupational argumentation repertoires.

There are many leaves, (visible differences) several branches (supporting beliefs and values) but what supports the differences is invisible, the cellular DNA (or assumptions) of the two types of plants. Due to practical considerations, it is not possible to consider all the leaves borne by the hybrid plant. The complexity of the organisational context, and the amount of material gathered through use of a qualitative approach could justify the production of a book of far greater size than is permissible for doctoral examination, or practical to write within the doctoral candidature.
Based on the interviewees’ descriptive data, a distant view of the grafted plant reveals there are obviously two distinct branches, described as worlds or tribes by members. These differences are explored through the perceptions of the inhabitants and in particular, the judgements they make of the other occupation. Then, the point at which the commercial branch splits from the research rootstock is analysed through progressive comparisons (Fitzgerald, 2002; Fitzgerald & Hayes, 2006) of occupational modes of working. Integrated, cross-case discussion substantiates the findings and responds to the research questions. This chapter ends with a summary of the boundaries between the occupational subcultures evidenced in the organisations participating in this research. Having progressed from the easily visible to the invisible, I then return to a specific visible difference and describe in detail in Chapter 7 how argumentation style contributes to perceived boundaries and can influence commercialisation outcomes. This is in preparation for recommendations to improve the management of occupational boundaries in Australian CRCs in the final chapter.

The final chapter, Chapter 9 Implications and Recommendations, discusses the impact of occupational subcultures on commercialisation and implications for management practice. The use of boundary-spanning individuals and process theories of innovation
are reviewed for their potential to assist in the management of the contested “border territories” within CRCs. Chapter 9 also states the limitations of the study and identifies important topics for future research.

As detailed in chapter 3, page 43, a cursory inspection of members of research and commercial occupational subcultures could lead an observer to declare that they share much in common and to predict collaboration could occur with few impediments. Two groups of university qualified, office dwelling, primarily male knowledge workers with similar myths lauding the achievements of heroic loners, (Bragg, 1998; Fara, 2004; T. S. Kuhn, 1970; Schein, 1995; Ziegler, 1997) would appear well matched. However, using occupation of common territory and possession of similar backgrounds to define occupational communities has been criticised as ‘… especially misleading’ (Van Maanen & Barley, 1984, p. 295). Furthermore, as Schein has asserted, the deepest levels of culture are cognitive: ‘… thought processes that the group comes to share will be the ultimate causal determinant of feelings, attitudes, espoused values, and overt behavior’ (Schein, 1990, p. 111). The thesis results delve beyond visible “surface” similarities to identify the different and conflicting assumptions, values and norms that contribute to the tension and frustration reported by members of commercial and research occupational subcultures in the CRCs studied.

6.2 Description of the Four CRC Organisations Recruited

Table 6.1 presents a summary of the structural characteristics of the four CRCs providing the organisational context for the research. Researchers have previously investigated the impact of funding, age and size of organisation and innovation outcomes (Epton et al., 1983; D. O. Gray et al., 2001; Kassicieh & Radosevich, 1993). However, the numbers presented here are for descriptive, not analytical purposes as occupational cultures form the focus of this research. Ranges rather than exact figures
are provided for each attribute, (such as number of employees) to protect the anonymity of each CRC.

In addition to meeting the recruitment criteria of current vs. graduate status in relation to the CRC program, and spread over two industries, Table 6.1 below shows other forms of variation between the organisations which are expected to assist in examination of the research questions. Specifically, the maturity of the organisations ranged from two to twenty years. A single interview with a manager from a CRC that had successfully applied for funding, but had not yet received its first payment and was in the initial stages of negotiation between public and private sector parties, further extended the range of organisational maturity. The size of the network of member organisations in the four CRCs varies from twelve or less for the Biomedical Current CRC to over thirty-eight for the IT Current CRC. While three of the organisations have a similar number of full-time equivalent staff, the IT Graduate CRC had more than 150 full-time equivalent members and post-graduate students, excluding members of companies spun-off from, but still affiliated with the CRC. The size of the organisations recruited provides opportunity for subcultures to be apparent if they exist. Finally, the funding provided through the CRC program ranges from A$ 5 M up to more than A$ 25 M, which may influence commitment from members based on perceptions of the significance of the funding to their continued operations.

The diversity of organisations recruited improves the credibility and verifiability of the research through providing a range of organisational environments in terms of age, composition, size and industry in which to explore the research questions (Creswell, 1998).
Table 6.1: Summary of Recruited CRCs

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2 years participation in program</td>
<td>Participated in program for 14 years (two rounds of funding)</td>
<td>7 years participation in program, seeking an additional round of funding</td>
<td>Participated in program for 14 years (two rounds of funding)</td>
</tr>
<tr>
<td>Size: Number of Participating Institutions</td>
<td>Private Cos. ≥30</td>
<td>Private Cos. ≥15</td>
<td>Private Cos. ≤3</td>
<td>Private Cos. 1</td>
</tr>
<tr>
<td>Academic Institutions</td>
<td>≤ 3</td>
<td>Academic Institutions ≤ 5</td>
<td>Academic Institutions ≤ 3</td>
<td>Academic Institutions 0</td>
</tr>
<tr>
<td>Government Bodies</td>
<td>≥ 5</td>
<td>Government Bodies ≤ 5</td>
<td>Government Bodies ≤ 3</td>
<td>Government Bodies 0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>Other ≤ 5</td>
<td>Other ≤ 3</td>
<td>Other 0</td>
</tr>
<tr>
<td>Size: Individual Participants</td>
<td>Full Time Equivalent Staff ≥ 40</td>
<td>Full Time Equivalent Staff ≥ 100</td>
<td>Full Time Equivalent Staff ≥ 50</td>
<td>Full Time Equivalent Staff ≥ 40</td>
</tr>
<tr>
<td>Physical Locations</td>
<td>Spread across all Australian states.</td>
<td>Spread across three states.</td>
<td>Spread across three states.</td>
<td>New South Wales</td>
</tr>
<tr>
<td>Approximate Annual Funding (from all sources)</td>
<td>≥ A$ 10 M</td>
<td>≥ A$ 25 M (In last round of funding, has now ceased operations)</td>
<td>≥ A$ 5 M</td>
<td>≥ A$ 10 M (Approximate annual operating budget, no longer funded by CRC Program.)</td>
</tr>
</tbody>
</table>

Summaries of the interviews conducted in each of the four CRCs participating in the research, and the secondment status, gender, age, length of employment in CRC member organisations and educational qualifications are contained in Appendices 4, 15, 16, 17, 18, 19 and 20. Having provided an overview of the four organisations recruited to participate in the research, presentation of the occupational classification of the interviewees follows.

6.3 Occupational Membership

The demographic questionnaire (see Appendix 12) asked participants to provide their job title and identify themselves as belonging to one of three wide occupational groups: scientific, engineering or managerial. If the participants said their role spanned two of these groups, their selection of the discipline in which they held academic qualifications provided a starting point for me to probe their response. This recognises the importance of self-identification and ‘consciousness of kind’ (Trice, 1993, p. 32) to occupational membership, as only the members of an occupational community can determine who is included within the boundaries of that community. There is a significant distinction between people who consider themselves “to be” members of the same occupation and others who maybe included in an externally imposed scheme of job classification is significant (Van Maanen & Barley, 1984).

Even so, some participants had difficulty selecting a single occupational group. One individual, who had previously held a professorial position, but then performed an executive management role in a CRC while continuing to lodge patent applications, commented that he was uncertain if he really belonged to a single occupational group. However, he eventually selected the scientific category. In a later interview, an informant from a different CRC, who self-selected the managerial occupational category, volunteered without prompting the following in reference to the boundary-crossing individual described above:
I haven’t seen that many really good CRCs. Perhaps the IT Graduate CRC which did set up a number of different companies that seemed to be going ahead well but I’d like to look under the rocks in that area because [identity removed] looks like an awfully academic sort of scientist to me from the outside. I’ve never met him, …” (Manager, Biomedical Graduate)

The above demonstrates that participants were encouraged by the researcher to reflect upon their primary occupational community and culture during completion of the demographic questionnaire to focus upon occupational membership rather than job titles. Furthermore, other respondents occasionally corroborated these choices. The self-identified occupations of all interviewees are contained in Table 6.2 below, showing that recruitment produced a balance of researchers and managers. Engineers were interviewed in three of the four organisations. At the outset of the research, it was not clear if the engineers would belong to research or management cultures or constitute a separate occupational culture.

Table 6.2: Self-Reported Occupational Membership, Total and by CRC

<table>
<thead>
<tr>
<th>CRC</th>
<th>Researcher</th>
<th>Engineer</th>
<th>Manager</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Graduate</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>IT Current</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Biomed. Graduate</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Biomed. Current</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Interviews Outside CRCs</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Demographic questionnaires completed at first interview.

In summary, the recruitment results met the goals described in section 5.2 of the Methodology chapter and Appendix 9, in relation to both organisational and individual characteristics.
6.4 Research Questions

The research questions investigate the thesis proposition, which is that occupational subcultures exist within CRCs and impact commercialisation outcomes. The research questions are:

1. Do members of CRCs engaged in commercialisation recognise subcultures in their organisations and if so, how do they describe and identify the subcultures?
2. What can be determined about boundaries between subcultures in terms of shape, thickness and permeability in the context of commercialisation practices and outcomes?
3. How do CRC members perceive that occupational subcultures impact upon their work?
4. How can occupational boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?

The next section of this chapter investigates and discusses the findings pertaining to the first three research questions: existence, boundaries and impact of occupational subcultures in commercialisation. The thesis’ final chapter provides recommendations to manage the impact of occupational subcultures in Australian CRCs and in doing so addresses the last research question.

Complexities and contradictions abound in hybrid organisations due to their impermanence and the challenges of supporting the occasionally conflicting objectives of member organisations (Barringer & Harrison, 2000; Borys & Jemison, 1989). All respondents spoke of occupational subcultures and some added structural and political perspectives. For instance, commenting on the challenges associated with conflicting organisational objectives a researcher explained:
“It’s a real struggle in CRCs where directors are put in almost impossible situations of having to protect the interests of their company and also always working for the best benefit of the CRC, which often involves creating a market for the Intellectual Property. ...a lot of ideas created in the CRC never get commercialised, because [the commercial] participants really don’t have a particular interest in doing so.” (Researcher, IT Graduate, emphasis by speaker shown underlined)

Similarly, a Biomedical Current CRC manager identified the contradiction between researchers’ desires to cure an underlying medical condition with the likely consequence for their commercial partner; it would no longer have a market for its medical devices. Examples of political and structural themes included: government and industry pressures for a rapid return on investments, alliances between particular hospitals and/or universities that prevented other institutions from participating in a CRC, and the challenges of generating personal loyalty or commitment to a temporary organisation. The difficulties of structuring a CRC to accommodate simultaneously collaborative and competitive relationships, or co-petition (West & Gallagher, 2006) also arose. Discussing political and competitive factors, a manager commented:

“Well, I mean the CRC is not your typical organisation is it? By any stretch of the imagination. There’s a range of politics operating within the CRC. The universities see themselves in various pecking orders as regards which projects are being run by which universities and the level of funding for those projects. Within the [group of industry partners], there is understandably normal commercial competitiveness. They don’t all have common interests. Some of them certainly do live in the same marketplace and that creates an interesting dynamic. How do they sit down at a table together and decide which projects they’re going to invest and share their intellectual property in? Under normal circumstances they wouldn’t necessarily be doing that with another private sector organisation. ...The government agencies’ interests tend to be not as complicated perhaps and in many instances, not as competitive.” (Manager, IT Current)

However, as previously stated, this research focuses on occupational subcultures in commercialisation and is not intended to address structural or political issues associated with CRCs in Australia. Nonetheless, these issues present potential avenues for future research. The current study investigates the potential existence, and impact, of occupational subcultures on the commercialisation phase of innovation. The research questions concern if and how occupational subcultures
affect commercialisation processes and if the formation of occupational subcultures has managerial implications for the attainment of organisational goals.

The research findings, as is the case with all qualitative work, are constrained by time, place, and the changeable nature of individual perspectives. Consequently, the findings cannot be readily extrapolated into other contexts. However, the insights provided by the interviewees have the potential to extend existing theory by considering the impact of occupational subcultures on the functioning of hybrid research centres, and provide directions for future research.

I would like to stress that the participants clearly supported the idea of linking research producers with research users in general, and the CRC program in particular, despite encountering difficulties. They were not critical of the intent of the program and were often, on both a personal and professional basis, enthusiastic about the potential outcomes. However, the informants did report practical difficulties in implementing the CRC concept, as exemplified by the following comment:

“To talk about collaboration and cooperation is one thing. To actually have to put it into practice in the formal structures! It’s all a learning experience for us.” (Manager, CRC in formation)

Consequently, the opinions expressed are unlikely to be tainted by dissatisfaction with the notion of hybrid industry-research centres.

The first three research questions are now addressed through use of Progressive Comparative Methodology (Fitzgerald, 2002; Fitzgerald & Hayes, 2006), to conduct comparisons between individuals and also across, and within, organisations and occupations. The remainder of this chapter consists of presentation and discussion of evidence for the existence of occupational subcultures, the classification of the subcultures encountered, a selection of physical manifestations and the norms, values and assumptions that support perceptions of difference, and key boundary constructs. The identification, and exploration of two broad occupational subcultures: research and commercial, provides answers to the research questions.
6.5 Identification of Occupational Subcultures

The interviewees demonstrated clear familiarity with the concept of occupational subcultures and several commented on the importance of the research topic to them. They freely described visible signs of occupational groupings working in commercialisation, the values and beliefs of particular cohorts, and perceived boundaries between occupational subcultures. Such ability to rapidly grasp and articulate the notion of occupational subculture could possibly be attributed to acumen and education. However, the emotionally charged responses, often expressing frustration, suggest that the impact of different occupational assumptions, values and norms in commercialisation extends beyond mere intellectual awareness. For example:

“…it used to frustrate me that some of the issues that I knew as a scientist were very complex, the managers who were not necessarily scientists had an innate belief that these things could be engineered rather than needing any research and it was just “Tell me how much you need and how many people and woof!”” (Researcher, Biomedical Graduate)

A commercial engineer provided a counterpoint in describing the difficulty of working with engineers engaged in pure research, conducted to advance knowledge without any intended application:

“I found it difficult and frustrating sometimes that they didn’t, in my opinion understand that we had deadlines. Although they were a group with similar backgrounds and qualifications that is probably not the most significant factor. The programs of their work were so distinctly different. Fundamental research vs. practical implementation made it [collaboration] impossible. We stopped working with them because we were going nowhere.” (Commercial engineer, Biomedical Current)

In fact, the informants were unanimous in stating that their experiences left them in no doubt about the existence of occupational subcultures in each of the four CRCs. The twenty interviewees commented on the influence of occupational subcultures and the necessity of combining occupational skills and cultures in commercialisation activities. For instance, in the view of a researcher:
“They [occupational subcultures] absolutely exist and are critical for success. Appropriate at different times in terms of which subculture takes the lead and the mix is critical, if you have more one than the other at the wrong time and the wrong ones then you’re not going to progress.” (Researcher, Biomedical Graduate)

Several interviewees used terms such as “tribes” or “different worlds” in their descriptions of commercialisation. For example, when asked if there was an overarching (integrated) organisational culture in the CRC a manager from a private company explained:

“…there’s no written expression of what the culture is, but you pick it up from the vibes, the meetings, … I think it’s a very collegial sort of atmosphere.” (Manager, IT Current)

He then continued to describe the CRC as presenting a differentiation perspective of organisational culture:

“It isn’t a sort of umbrella sort of atmosphere though. There’s a recognition that there are different tribes or cultures within it … you’d end up with different results if you said to some of the key players, “Here are some descriptions of culture, can you use that information to write out what the CRC’s culture is?” You’d end up with a fairly wide range of results I would think.” (Manager, IT Current)

In discussing the challenges of getting commercial and research occupational groups to work together, a researcher from the Biomedical Graduate CRC said, ‘I think you are in for a lot of trouble if you try to mix the two worlds.’ His clear preference was to keep the occupational communities, and their cultures, separate and elaborated:

“…the processes in place in terms of peer-review, in assessing the diligence and efficient use of resource in the scientific world are governed by totally different rules because of what you’re seeking to achieve than those in the engineering world. What people have not yet fully embraced is how to bring those two schemas together. You can see that business and engineering in Australia frequently fail because it does not have a sufficient understanding of the high level of the rigour and toughness of the monastic [research] world.” (Researcher, Biomedical Graduate)

Differences between the occupations were evident to the research participants, regardless of CRC funding status or industry sector. An alternative explanation to
occupational cultural differences as the genesis of the friction reported between occupational groups, is that stereotyping, based on beliefs that all members of a particular group are similar, and think and behave in the same way (Trice, 1993), coloured participants’ experiences. However, frequent contact between individuals of similar status, cooperating in working towards common goals, has been demonstrated to reduce stereotyping based on age (Hale, 1998), race (Dixon & Rosenbaum, 2004) and nationality (Stangor, Jonas, Stroebe, & Hewstone, 1996). These conditions apply in CRCs. After extensive periods of work contact, in some cases more than twenty years, observation and engagement inform the CRC members’ reports of occupational difference, not simple stereotypes. Interestingly, while effective in ameliorating stereotypes, contact may not reduce perceptions of difference in inter-occupational relations. A study tracking the impact of contact between undergraduate physiotherapy and podiatry students showed perceptions of difference were stable or increased, rather than decreased, after attending courses together (Mandy, Milton, & Mandy, 2004). Consequently, perceptions of difference based upon occupational membership within CRCs may also remain stable or increase over time.

The data presented thus far support the thesis that occupational subcultures exist and affect commercialisation outcomes in the CRCs examined, and refute the rival explanation of stereotyping for perceptions of difference between the groups. The characteristics of the main subcultures identified by the interviewees are discussed next, followed by exploration of the constructs which separate the occupational subcultural groups.

### 6.5.1 Classification of Two Broad Occupational Subcultures

While there was unanimous agreement that occupational subcultures exist and affect commercialisation outcomes, there were differences of opinion regarding the extent of the separation between the occupational subcultures. Informants described “two tribes” (research and commercial) or “three tribes” (researchers, engineers and managers, or commercial, government and research/academia) co-existing in the
same organisation. Comparison of the interviews, and probing the material from the four engineers using Progressive Comparative Methodology (Fitzgerald, 2002; Fitzgerald & Hayes, 2006), leads me to categorise the participants into two broad occupational subcultures, based on commercial and research membership. Other subcultures undoubtedly exist. For example, two managers referred to a cross-industry network of CRC CEOs who gave each other advice on matters such as preparing bids for a second round of seven-year funding. However, this research will focus on commercial and research occupational subcultures as the categories that appeared most salient to the participants when discussing the impact of occupational subculture on commercialisation. Before detailing the cultural forms, norms, values and assumptions associated with the research and commercial subcultures, the engineers’ responses, in addition to theory related to engineering as an occupation, are reviewed as justification for splitting the four engineering participants between commercial and research occupational cultures.

6.5.2 Engineer: Commercial or Research Occupation?

Four of the twenty informants selected the engineering occupational category in the demographic questionnaire, compared to eight in each of the commercial and research categories. Two of the engineers were full time academics, employed by a university, held PhDs and saw themselves as researchers. Private businesses employed the other two engineers. These men identified themselves as part of commercial units within the businesses, and one held a bachelor and the other bachelor and masters degrees.

Interviews with engineers occurred in three of the four CRCs. A researcher explained that there were no engineers in the fourth CRC:
“...the last few years the CRC was really struggling and it was trying to go from fundamental [research] down to really, just the engineering level, to deliver the prototypes and I think there was a fundamental problem with that because it required just different skills you know, engineering skills which were not present in the CRC.” (Researcher, IT Graduate)

This comment suggests that he viewed engineers as performing a “bridging” function between pure and applied research. Similarly, when asked why business people might be unwilling to spend two weeks in a research institution in order to gain an understanding of the challenges associated with performing non-routine work to commercial schedules, another researcher replied:

“I don’t think it would make sense. Yeah, I think they would want to look at the project through the filter of their own engineering people. It would make more sense for those engineering people to come here, they could communicate better with the scientists here and if I was them, that’s what I’d do.” (Researcher, Biomedical Current)

While these comments suggest engineers connect research and commercial occupations, the four engineers participating in the research identified with either research or commercial occupational cultures. Furthermore, unlike the researchers turned managers, the engineers did not appear to hesitate over their choice.

In addition, the engineers described two disparate sets of motivations and goals. For instance, a commercially employed engineer identified himself as part of the “operations” group rather than what he termed the “scientific establishment” and described his motivation for entering the CRC as:

“... for all the people you brought in for the operations side [the motivation] was money. It was money you know, and that’s OK because for me I walk in and in less than a year, I’ve made a name for myself and done a great thing.” (Commercial Engineer, Biomedical Graduate)

The engineers working in a university context, who spoke of desires for their work to provide public benefits and de-emphasised monetary rewards, offered a different motivation. For example:
“…for us I guess it’s more motivated by the research itself, not necessarily by the economic benefits…. If we say “This is something I really want to contribute to, to make a difference,” then we will do it. It’s not necessarily about “This will give me better pay.” (Research Engineer, IT Current)

In contrast to the primacy of monetary rewards for the commercially oriented engineers, the engineers employed in research positions expressed hopes of their work providing a legacy of new research and business opportunities. While keen to see their work commercialised, personal financial gain did not appear to be an expected outcome. For example, a research engineer summarised his career goals:

“I would certainly be very proud if in about five or ten years time I could say, “Well, I started that industry or business in Australia.”” (Research Engineer, IT Current)

The difficulties of generalising about engineering occupational culture have been documented (Bailyn, 1985; Kerr & Von Glinow, 1977). Tornatzky and Ostrowski (1994) grouped engineers with scientists as inventors: willing to tolerate experiential, conceptual, or perceptual ambiguity. In addition, when asked to produce commercial products, Tornatzky and Ostrowski viewed scientists and engineers as ‘disabled by their training and professional socialisation’, liable to ignore end-user needs and applications, occupying occupational “ghettos” and asserted they ‘…tend to talk to scientists and engineers, and talk only to engineers and scientists in comparable-sized institutions’ (Tornatzky & Ostrowski, 1994, p. 139). Similarly, the value system of engineers has been predicted to be closely related to that of physicists (T. S. Kuhn, 1977), providing another instance of scientists and engineers being grouped together.

However, after reviewing the research literature to develop a model of an “ideal” profession and assessing the conformity of different professions to that ideal, Kerr & Von Glinow (1977) concluded that engineering and management are not true professions. Engineers frequently aspired to management positions, which rely less upon the use of certified knowledge. This is consistent with Australian data which shows ‘… a pronounced movement of engineers into managerial level jobs a decade after qualifying’ (Science and Innovation Mapping Taskforce, 2003, p. 228). Both engineers and managers valued the judgments of their managerial superiors more than the opinion of their professional peers and worked towards organisationally
selected goals, with limited strategic or operational autonomy (Kerr & Von Glinow, 1977). Scientists, however, did show characteristics of professionals:

Depending upon the amount of specialised training, type of research setting, length of time employed by the organisation and other circumstances ...the research literature does suggest that scientists in many technical specialities do exhibit the autonomy, identification with profession, commitment to speciality and expertise based on abstract knowledge required by the definition (Kerr & Von Glinow, 1977, p. 340).

Consequently, the division of the four engineers into commercial and research occupational subcultures is consistent with existing theory and justified based upon the individuals’ own occupational identification (Van Maanen & Barley, 1984).

The possession of postgraduate qualifications had been identified as a potential boundary construct between research and commercial occupational subcultures in the exploratory interviews (Hayes & Fitzgerald, 2005). However, in addition to forming a boundary between research and commercial occupational subcultures, postgraduate qualifications formed a boundary within the engineering occupation, into research and commercial engineers. This finding was unaffected by the age of the organisation or its industry sector. In summary, the research participants split into two equal groups, each containing ten self-identified members of research or commercial occupational subcultures.

An exploration of the contrasting characteristics of research and commercial occupational subcultures, based on the shared perceptions of members of these occupational subcultures in the four recruited CRCs, is contained in the next section.

6.6 Subcultural Boundaries: Perceptions of Similarity and Difference

The ability to identify who belongs, who does not, and why they do not belong, is clearly central to membership in an occupational subculture (Trice, 1993; Van Maanen & Barley, 1984). In addition, members’ definitions of who is an outsider set the boundaries of occupational subcultures. Douglas (1982) posits that all arguments in groups hinge upon drawing the group’s boundary closer or relaxing it, whether to
make more, and apply rules more strictly, or relax the group’s rules. Accordingly, perceptions of similarity and difference are important to the CRC context. I will now present evidence of consistent perceptual patterns of commercial and research occupational subcultures in the four organisations explored and relate the identified features of research and commercial occupational subcultures to previous research. I will then extend existing occupational cultural theory to include inter-occupational argumentation and commercialisation in hybrid research centres.

### 6.6.1 Boundaries within the Cooperative Research Centres

The informants clearly described several types of boundaries in CRCs, including inter-organisational boundaries, physical and inter-occupational. Inter-organisational boundaries are manifested through descriptions of inter-university rivalry and competition between commercial members of CRCs. The physical boundaries were based on geography, as some researchers perceived working in Australia to be a barrier to garnering international attention and access to experienced commercialisation managers. However, the most frequently mentioned type of boundary was inter-occupational, between commercial occupations such as managers, design and production engineers and researchers. The prominence given to discussion of occupational subcultures reveals the boundary between commercial and research subcultures as highly salient, and supports the differentiation perspective of organisational culture (J. Martin, 2002; Meyerson & Martin, 1987) as being dominant in CRCs. The interviewees’ descriptions of separate groups working inside strong boundaries within the CRC organisations are not consistent with the cultural homogeneity expected from an integrationist view of occupational culture.

### 6.6.2 Description of Occupational Subcultural Boundaries

The boundary characteristics inferred from the testimony of the informants can be summarised as highly visible and salient, generally impermeable and durable. Although there are signs of a slight reduction in the strength of the boundary between
commercial and research groups, potentially due to government intervention, the evidence below suggests that the two groups will continue to be separate and distinct.

### 6.6.2.1 Salience

As described in section 6.5 of this Results chapter, Identification of Occupational Subcultures, the boundary between research and commercial occupational groups was highly salient. All interviewees described two distinct worlds existing within CRCs and influencing commercialisation outcomes. In addition, comments about the importance of the research topic to the informants support the view that the industry-research boundary is highly salient. For example, researchers expressed surprise that previous work on CRCs had not directly considered occupational subcultural conflict as it was clearly an issue they grappled with on a daily basis. Similarly, business members of CRCs described the difficulties they had adjusting their usual mode of operation to accommodate the norms and expectations of researchers. Based largely upon the material already covered in section 6.5, I conclude that the boundary between research and commercial occupational subcultures in the CRCs explored is both highly salient and highly visible.

### 6.6.2.2 Permeability

Three types of permeability of the research-commercial boundary were apparent in the interview data. Boundary permeability is reviewed first in the context of the movement of individuals between occupational communities, second through the action of individuals who span the boundary between the two groups, and third through processes that span both occupational groupings and the exploration and exploitation phases of innovation.

#### 6.6.2.2.1 Movement of individuals and secondment

I interviewed two people who have moved from research positions to business management positions but found none who have moved from management to research roles. Potential explanations include that the possibility that the boundary is thicker around research roles and that incentives may exist for a researcher to move to a commercial role, but the same may not be case for the majority of commercial
workers. As previously described, members of commercial communities reported monetary rewards to be their key motivator. Hence, in addition to having to undergo an extended journey through post-graduate courses and junior research positions before regaining a position within the research community equivalent to that of an experienced commercial manager, the relatively low salaries paid to researchers would discourage business people from making the move. However, commercialisation success could offer a new route to recognition and visibility for researchers. Boundaries may be somewhat permeable in both directions, but only one-way movement, from research to commercial occupations, supports researchers’ desires for recognition. A Biomedical Current researcher rejected the suggestion of even a temporary, two-week secondment of commercial actors into a research laboratory, interrupting me to say:

“I can’t imagine an actual business management person from one of the companies wanting, choosing to come here… I don’t think it would make sense.” (Researcher, Biomedical Current)

Significantly, researchers who cross the boundary to take up management positions in CRCs may not be completely accepted as a “native” by managers with purely commercial training. As described earlier in this chapter, a commercial manager talking about another manager who had previously been a senior academic expressed some suspicion about the CRC’s success because “X looks like an awfully academic sort of scientist to me from the outside. I’ve never met him.” While expanded recognition may provide incentive for researchers to move to managerial positions in commercialisation organisations, their ability to move does not guarantee acceptance by existing members of commercial occupations.

Another researcher, this time from the Biomedical Graduate CRC confirmed the notion of a particularly thick boundary around research occupations, describing them as closed communities with stringent entry criteria, punishing peer review and expulsion as the punishment reserved for transgressors against the scientific value system. However, he added that the boundaries between research and commercial organisations were not as strong as they used to be:
“People, I think, just accept CRCs. They’re no longer the social outrage that they were at the start where it was considered that it was just downright odd that people would talk about their work and downright odd that people entertain a career that was outside the womb to tomb career that CSIRO once offered.” (Researcher, Biomedical Graduate)

However, the research pre-history (Matthews & Frater, 2003) characteristic of many CRCs and other hybrid industry-research organisations may lead to family-like connections, which are difficult for outsiders to penetrate. In fact, two of the interviewees from the IT Graduate CRC referred to the other researchers in the group as “family”.

Two of the informants had been seconded to the Biomedical Graduate CRC from their member organisations. Six other interviewees referred to having their salary fully or partially paid for by funding from the CRC as a form of secondment but only two had experienced physical secondment. Appendix 16 shows the distribution of secondment of the participants by CRC. Secondment has been a traditional recommendation to assist crossing the boundaries between organisations and occupations (Epton et al., 1983; T. Kuhn, 2002). Despite the low use of physical secondment revealed in Appendix 16, managers in the IT Current CRC are interested in increasing and measuring secondment. When asked what actions were being taken to address the barriers to on time, on-budget delivery perceived by the corporate CRC members, a manager revealed:

“I’m going to each of the universities and saying to their deans “In principle, do you have any objection to your researchers being located with the companies or the government agencies?” And all of them are saying, “No, in principle we don’t have that problem and then I’ve waxed lyrical about the benefits of doing that and indicated that there’s a really strong desire for that to happen.”(Manager, IT Current)

He continued to say that the CRC board intends to measure the amount of time that researchers physically spend in the commercial companies as a way of getting researchers “closer to the research user in a really genuine sense.” The low incidence of secondment suggests that other mechanisms may be in use. The following section examines an alternative mechanism, using boundary crossers to link occupational subcultures in the CRCs.
6.6.2.2 Boundary spanners, brokers and crossers

Irwin, More, & McGrath (1998), Kuhn (2002), Matthews and Frater (2003) and Quirk (2005) argue that the existence of a “boundary broker”, “boundary crosser” or “boundary spanner” is vital to the success of inter-occupational collaboration. A boundary crosser is an individual who can operate across a variety of cultures. In the context of a CRC, a boundary broker will be skilled in operating in both research and commercial cultures. The interviews revealed several boundary crossers. For example, a researcher from the Biomedical Current CRC, when asked why he had not returned to academia as planned explained:

“When I moved into the organisation there were two subcultures which between them defined the whole culture [with] almost no point of overlap. The two groups lived on different floors and talked about each other. They had to communicate a lot, but there was very little understanding of, and very little sympathy towards one another’s points of view. There was often tension, sometimes useful, but sometimes not between the two subcultures. I think the reason that I slotted into this organisation so well is that I was the only person in the organisation that had training in both subcultures. And so I loved it from the start, it was a foot in both camps and it just made life much more interesting.” (Researcher, Biomedical Current)

While such boundary crossing individuals seemed able to frame-shift, they reported difficulty in incorporating aspects of one occupational culture into the other. For example:

“… having come back into CSIRO I’ve sort of reverted back into the government research laboratory type culture. I tried to bring some of that stuff from [the Biomedical Graduate CRC] here to some extent, but it is very different and getting people who’ve done science to move into a commercialisation mode is very, very difficult because you have to shift their culture somewhat.” (Researcher, Biomedical Graduate)

In addition, when crossing boundaries, individuals found themselves simultaneously subject to the norms of both occupational communities. These norms may sometimes be in conflict. For example, a researcher in the IT Current CRC described the case of an academic turned consultant, believed to have failed to acknowledge the contribution made by another researcher when presenting his credentials to an industrial client. The specialised research community responded by excluding that individual, and preventing them from boundary spanning in future. Similarly, a
researcher in the Biomedical Graduate CRC described the personal pressures of being a boundary crosser from pure research to advocating commercialisation:

“... it’s a terrible position to be in, because you’re all the time a charlatan. All the time you’re identified as the person on whom the responsibility rests both for painting the picture as well as producing the goods. It is obviously beyond the means of the scientist within the group to do anything other than sow the initial seed because, the money and control and the whole dynamic of enterprises, once they get to a certain stage they have a life all of their own” (Researcher Biomedical Graduate)

While individual boundary crossers may well play a vital role in translating and synchronising the needs and desires of the two occupational cultural worlds, reliance upon boundary crossers is not likely to be an adequate organisational strategy in itself. This is because there is no reliable way to ensure motivated and accepted boundary crossers exist in any hybrid organisation. Another approach to managing boundaries involves the use of boundary objects (Star & Griesemer, 1989). Description and discussion of a development management process in the Biomedical Current CRC that seemed to be fulfilling the functions of a boundary object follows.

### 6.6.2.2.3 Processes that link occupations and span boundaries

A boundary is not inevitably a barrier (Star & Griesemer, 1989). Boundaries can be interfaces which facilitate the production of knowledge, and “boundary objects” whether material objects, organisational forms, spaces or procedures, can enable communication between communities (Star & Griesemer, 1989). Some evidence found in the Biomedical Current CRC supported this view. The prime example in the Biomedical Current CRC was the Design Control Process (DCP), which, in addition to performing technical functions, helped to link and coordinate the activities of research and commercial communities. In fact, a commercial engineer described the DCP as functioning in a ritual role in linking the two groups, and assisting in guiding the design and manufacture of new products through the “grey zone” of transition from exploratory, research control to exploitative commercial control. The DCP culminates in a ceremony, called the Final Project Review Meeting, involving research, commercial and customer stakeholders and signifying completion of the project.
The DCP provides an opportunity to document and acknowledge the goals of different stakeholders, and may combine constructive elements of 5th generation and process models of innovation (Chesbrough et al., 2006; Rogers, 1996). The Biomedical Current Commercial Engineer gave examples of occupations failing to communicate earlier in the company’s history when they did not use the DCP, such as the researchers dismissing requests from the marketing department with, “... they don’t know what they’re saying, we’ll make it this way, they’ll like it in the end.”

A researcher from a different organisation, but part of the same CRC also reported the DCP easing the transition from exploratory phases, under the control of researchers, to the exploitative, focused, commercial stage:

“There’s quite a transition region where it changes from us being the driving force and them providing input, suggestions, guidance, equipment to them being the driving force and us providing input, suggestions, guidance and expertise. I hadn’t really thought of it this way until this conversation but I guess I could easily point to the month when that happened in the [most recent] projects. There’s certainly a change from us being the driver say “Are you interested?” to them saying, “Look, we’ve made a decision, we want to put this into a product and we’ve put together a project team.” And, phew, you can feel the relief around here, you know, this work’s not wasted, this work is going to go ahead and here’s the path that’s going to do it.” (Researcher, Biomedical Current)

The DCP serves to increase the amount of communication between, and time spent together by commercial and research groups. Through the series of formal meetings and negotiations about what is included in the current project and what is documented for consideration for future projects, the DCP could been seen as a structural intervention to increase time spent together at the beginning of the project cycle in order to reduce the overall cycle time through improving communication. This possibility, combined with the impact of research and commercial groups reaching small, documented agreements early in the project cycle may be acting as a substitute for secondment and boundary crossers, and represents a potential avenue for future research. The successful use of the DCP is of particular interest, because it provides a real-world example of process-based innovation management methods apparently reducing inter-occupational conflict. This result contradicts Benner and Tushman’s (2003) conclusion that process management techniques stabilise
organisational routines but make cross-boundary, cross-community linkages more difficult. There is a possibility that process management techniques may assist in navigating the boundaries of research and commercial occupational groups working in the commercialisation phase of innovation. This finding forms one of the recommendations for future research into improving organisational processes and outcomes in Australian CRCs.

### 6.6.2.3 Durability

As well as being thick and strong, the durability of the boundary between research and commercial occupations in Australia is also highly stable. Researchers proudly linked their occupations with the medieval, monastic search for knowledge and cited failed attempts to incorporate research into commercial entities as proof of long-lasting and stable differences:

“...that’s what the large pharmaceutical companies do, and they’re oscillating between “Oh we can’t deal with these unruly scientists, we’ll bring it inside.” And as soon as they do it’s “Oh, nothing is happening, we’re just spending money and there’s no inventiveness.” Much like outsourcing. They’ve done that twice now.” (Researcher, Biomedical Graduate)

Informants spoke of the value of the different contributions made by the separate communities and, by extension, the value of the boundaries that permit the useful differences to be preserved. Within hybrid industry-research organisations, one management challenge would appear to be to encourage sharing of complementary knowledge and abilities. Conversely, attempts to eliminate boundaries and merge the groups could destroy the potential for complementarity and negate any reason for collaboration. As will be discussed in the final chapter, the challenge of inter-occupational collaboration is fundamentally different from the task of integrating two departments in a merger between commercial companies. Producing organisational artefacts such as a polo shirt with a new organisational logo may be a useful starting point to getting members of the accounts department of one insurance company to extend their group boundary to include newcomers from the accounts department of another insurance company. However, in temporary, hybrid industry-research organisations the task is more complicated. Each community needs to simultaneously preserve its occupational differences, and accept the divergent modes of work,
motivations and myriad occupational norms embodied by complementary occupations and organisations.

Exploration of the characteristics of occupational subcultural boundaries in the four CRCs and evidence of changes to these boundaries follows. Permeability of occupational subcultural boundaries is analysed in depth prior to the recommendations for managing occupational subcultural boundaries in Chapter 9, the final Chapter.

### 6.6.3 Post Graduate Education as a Boundary Construct

The interviewees collectively viewed science as a closed community. There are stringent entry criteria, certified through formal degree conferring ceremonies, and community members are subject to rigorous peer review. Furthermore, transgressors against the scientific value system are expelled, consistent with the documented features of research culture (Gieryn, 1999; Merton, 1957). Working in commercialisation jeopardised continued membership in some research groups. For example, when asked how moving from a CRC back into a government research institute was perceived by researchers who had not left the institute, one researcher commented on the propensity for people within the research community to, in his words, punish commercial leanings:

> “…in [government research institute] … people here tend to judge others on similarity to themselves maybe, or to the academic. People who are more business orientated are viewed with some suspicion, going to the dark side, defecting, as well as [moving] to management. They are seen as defecting from the core body.” (Researcher, Biomedical Graduate)

Similarly, when asked how researchers view people in commercial occupations, and their use of CRC money for commercial activities, a manager retorted:

> “Oh filthy. Dirty, dirty, dirty. Despicable. Anything that comes between a researcher and a pot of money is to be denigrated and pushed aside.” (Manager, IT Graduate)
In addition to strict criteria for entry and continued membership, researchers, managers and commercial engineers identified a clear research hierarchy within the organisation, based on educational qualifications. One researcher drew an analogy between the workings of a research community and a monastery during discussion of the importance of autonomy as a research norm:

“Now the monks did live, and so do the scientists, according to an incredibly tight regime, ... science is incredibly strict. So, the idea of science being a tra-la-la freedom to act, it isn’t! It’s hierarchical beyond anything you would expect.” (Researcher, Biomedical Graduate)

Educational attainment featured as a method of establishing rank within and between occupations, as an engineer commented:

“...most of the lab assistants were post-doctoral fellows with PhDs and in excess of 30 or 40 papers to their name and I felt somewhat intimidated as a single-degree engineer, trying to get them to do things which they thought were far beneath them, but to me [it] absolutely had to be done.” (Commercial Engineer, Biomedical Graduate)

In one organisation, educational differences translated into separate and differently furnished working environments located within the same building. A commercially oriented engineer described physical separation between occupational groups:

“...they [engineers and scientists] were kept in different parts of the building...with like air-locks between them (laughing). It was set up that way. You had the operations area over here, then you had a long, skinny corridor with a couple of doors and then you had the scientists.... The seating density was much higher in the operations group, [but] nice and big up at the other end, and they [scientists] had embedded coffee rooms and things like that. It was wall offices and lots of glass. There was a blue collar/white collar thing. I don’t know whether that was intentional or it was the way the place grew.” (Commercial Engineer, Biomedical Graduate)

The engineer also referred to the scientists as “superstars”. By contrast, he termed members of commercial occupations “grunts”. While the engineer considered the physical division unintentional and a consequence of moving into existing offices, a researcher from the same CRC suggested otherwise. In fact, the researcher stated it to be a deliberate attempt “not to mix the two worlds”.
At an inter-occupational level, it appears that perceptions regarding the importance of postgraduate education are associated with condescending communication. Both research and commercial interviewees volunteered “arrogant” as a descriptor of the approach of scientists when dealing with commercially employed people or commercial processes. Consequently, education, and in particular postgraduate education, appears as one inferred boundary construct between commercial and research occupations in the CRCs studied, and was particularly evident in the Biomedical Graduate organisation. The discussion of inter-occupational argumentation in the next chapter draws upon the existence and impact of these research hierarchies.

6.7 Perceptions of Difference: the Underqualified and the Unworldly.

Beyond forming the boundary between engineers who identified themselves as researchers and those who self-selected a commercial orientation, post-graduate academic qualifications formed the basis of pervasive assessments of the “other” occupational subculture. Generally, researchers viewed commercial members of CRCs as less qualified for the positions they held in the organisation than themselves. Stable perceptions of difference held by commercial and research occupational groups are explored in the following sections.

6.7.1 Research Views of Commercial Qualifications

The recruitment of research talent from around the globe was contrasted to the employment of local managers, portrayed as “merely available”. Describing the importance of offshore recruitment of researchers a manager explained:

“We know that we want world-class research so somewhere in the mix we have to have very high quality, leading scientists. We’ve set up a structure which has got three or four very high quality, internationally recognised scientists.” (Manager, IT Current)
Likewise, a researcher commented on a perceived mismatch between commercial and research CRC members’ qualifications:

“...in the subcultures you have a different standard of expertise and professionalism. In the science area we became number one in the world in the field, you know, ...this is acknowledged externally. Number one science. We did not have a (tapping table) number one commercial, marketing, product etcetera team, and that creates a very interesting cultural aspect that we underestimate in terms of converting something into a practical aspect. So basically, we have this very mediocre [commercial] skill base in this country. You put that together with outstanding, number one, science. You get clashes occurring there.... Now if you’re used to working with those who are number one in your field, you can call it arrogance or you can call it whatever, the respect issue is very difficult when ...you are dealing with someone who doesn’t know their own job.” (Researcher, Biomedical Graduate)

Other researchers expressed the view that managers accepting high-risk roles in CRCs, with no guarantee of work beyond the seven-year funding cycle, were of dubious competence. They felt that in Australia, successful, experienced managers found managing large, stable businesses easier and more lucrative than taking career risks in a small hybrid commercialisation organisation with only an outside chance of success. As explained by a researcher:

“I think the probability of not very well qualified people appearing in the start-ups is quite high and the reason for that is it’s just the whole environment is quite unstable. It’s pretty small, it doesn’t have enough experience, it has a certain culture, the culture has to change from academic to more commercial and therefore it needs people with commercialisation experience. But experienced managers with good track records are pretty rare. So there are more people from the failed start-ups because ninety per cent of start-ups in the States fail. So there are always a lot of people of this calibre, you know, not really there.” (Researcher, IT Graduate)

Several commercial informants perceived the use of post-graduate qualifications to assess the ability of individuals to contribute to commercialisation as problematic. A commercial engineer described the contribution of educational differences to the development of a competitive relationship between research and commercial organisational functions as follows:
“The operations executive didn’t have anything close to the academic qualifications that the technology executive of the CRC would consider being adequate …The operations executive thought the people in the technology area had nowhere near the commercial savvy required … That could have been seen as a collaboration but it turned into a confrontation often…” (Commercial Engineer, Biomedical Graduate)

The two commercial members of the Biomedical Graduate CRC interviewed were clearly aware that their qualifications did not impress their research counterparts. A commercial engineer compared his level of educational attainment with that of lab assistants, and reported difficulties in gaining recognition as an equal partner in commercialisation. Similarly, a manager from the same organisation commented about the trouble he had in gaining, in his words, “influence and control” over the organisation:

So it’s often very difficult. I don’t have a PhD. It would probably be easier if I did. But there are relatively few PhDs that can talk to the business side of things. There’s a few, but very few. And ultimately, we’re asking non-scientists to invest so we do have to meet their criteria. (Manager, Biomedical Graduate)

In summary, research members viewed their qualifications as superior to those possessed by their commercial counterparts, and justified a “diva culture” among researchers through peer acknowledgement of being “the best in the field”. As a researcher asserted:

“Where did all of the early 20th century come from? It came from screwball Hungarian mathematicians you know in the 19th century that solved problems that no one had the slightest interest in and they did it for the sheer glory and beauty. It came from a small coterie of tremendously arrogant people who were in their own little group of Prussian Hungarian German mathematicians.” (Researcher, Biomedical Graduate)

A broad view of Australian managers as second rate, compounded by a lack of occupational certification and peer review of performance, and ultimately undeserving of occupational respect was apparent in the interviews with researchers. Commercial engineers and managers were cognisant of the researchers’ view that they were less well qualified, but did not accept the judgement as justified given the different function of postgraduate qualifications in their occupational community. A
CEO may hold an MBA, but in most commercial communities a PhD would indicate an academic not a senior manager (Collier & Wilson, 1994).

Accordingly, post-graduate qualifications comprise a clearly visible boundary between the two occupational subcultures. However, the external conferring of degrees does more than provide the opportunity to use honorific titles such as Dr to distinguish between members of research and commercial groups. It is an artefact of two very different approaches to work, based upon divergent belief systems and conflicting occupational assumptions. Examination of these deeper beliefs and assumptions occurs in the remainder of Chapter 6 through a comparison of the two occupational subcultures’ differing approaches to work. Then, in Chapter 7, a detailed analysis of evidence of occupation specific modes of debate illustrates some of the occupational subcultural foundations for CRC members’ perceptions of difference.

Based upon the data collected, inductive theory generated from that data, and authentication of the theory through the anecdotes and quotes in the above sections, I conclude that occupational subcultures do exist in the four CRCs explored. Participants were unanimous in their opinion that research and commercial occupational subcultures exist, are necessary to the commercialisation of innovative ideas, and possess divergent assumptions, beliefs and norms that hinder collaboration. Furthermore, Progressive Comparative analysis (Fitzgerald, 2002; Fitzgerald & Hayes, 2006) of the boundary node created from the interview data reveals post-graduate qualifications act as one visible indicator of research or commercial occupational membership.

I conclude the following in answer to the first two research questions (p. 64). Members of CRCs recognise clearly defined occupational subcultures, broadly composed of research and commercial personnel. CRC members used postgraduate qualifications to identify subcultural membership, in addition to other criteria such as pattern of behaviour, some of which are examined in the next section. The boundaries between research and commercial occupational subcultures are salient, thick and strong, appear to be semi-permeable in one direction only, from the research to the commercial side and are durable.
Interestingly, the respondents recognise an occupational cultural paradox in their organisations. The qualities that make members of the two occupational subcultures attractive to each other simultaneously create barriers to working together. Examination of potentially complementary, but innately oppositional occupational cultural characteristics occurs in the following sections. Consistent differences associated with exploration or exploitation (March, 1991) as the primary occupational work orientation are identified. The dichotomy between exploration and exploitation, encapsulated in occupational subcultures in the four CRCs recruited to the research, constitutes an invisible, but potent source of tension between the commercial and research occupational subcultures at work in the CRCs.

6.7.2 Commercial Views of Researchers’ Exploratory Behaviours

Balanced against research views of commercial actors being under-qualified, the ten interviewees who identified themselves as commercially oriented expressed some irritation with what they saw as child-like, “unworldly” or naïve behaviour on the part of researchers.

“One of the very strong things that comes through in mindset in CSIRO and in universities, there is an absolute belief in the value of science and, I suppose, a complete lack of understanding about the degree to which publicly funded science ought to be competing for funds with other ways of spending public money.” (Manager of innovation, interview outside CRC organisation)

Further evidence for this assessment exists in the reasons offered by commercial interviewees for delays in commercialisation and in their prescriptions for managing researchers. For example, a commercial engineer explained that the operations group in one CRC believed that:

“…the scientific establishment was dragging the chain, was uninterested in actually making a product. They were more interested in just playing with test-tubes.” (Commercial Engineer, Biomedical Graduate)

A manager from IT Graduate CRC criticised the granting for money for fundamental research as “giving them money to play and be creative, and not …be commercial”
and in the IT Current CRC, a manager commented on the perceived inability of research members to participate as full partners due to displays of “immaturity”:

“Well I suppose that revolves around the maturity of the players ... In many instances, you’ll find a bit of dummy spitting [by researchers] takes place you know. And because you get a bit of professional esteem, egos and these sorts of things at stake... Because if it isn’t their idea, well then they’re not that interested.” (Manager, IT Current)

In being identified by commercial members as liable to “spit the dummy” (baby pacifier) if they don’t get their own way, not only are researchers compared to children, but to badly behaved children. A manager from the Biomedical Graduate CRC, talking about altercations he had witnessed between academics, confirms this interpretation:

“Behaviours I’ve seen in academia are just atrocious and wouldn’t be tolerated in any real organisation.” (Manager, Biomedical Graduate)

Commercial participants spoke of a need to manage researchers, almost as if they were juveniles who would unwittingly give away commercially valuable information in their attempts to bolster their reputation with their peers. Explaining how to instruct researchers to “get the message about protecting their ideas” a manager offered:

“We just wouldn’t let them go to conferences until they lodged their report of invention and if it was deemed worthy bung in a provisional patent. That was just part of the rules and they did understand that in the end.” (Manager, IT Graduate)

Similarly, in the IT Current CRC a researcher described visiting an organisation that had previously shown interest in his work, had requested and received information from him, but had taken no action. Recently, the researcher and the CEO of the CRC revisited the company. During the meeting, the CEO made it clear that the opportunity for that business to monopolise use of the research was no longer available. Furthermore, the CEO of the CRC in formation identified the technology transfer officers from the universities’ research and commercialisation offices as “minders” for the academics. A pervasive view of researchers as childish and in need of commercial supervision appeared from the comments of commercial informants.
Two important questions arise from this theme. First, what explanation exists for the perception of the attitudes and activities of distinguished, world-renowned researchers as childish? Then, how can members of research and commercial occupations collaborate as equals when one group views the other as sadly under-qualified and the other group perceives the first as childish? The impact of opposing patterns and models for producing work in commercial and research occupational subcultures is now investigated through the use of March’s (1991) notions of exploitation and exploration.

6.7.3 Childish or Childlike? Creativity and Exploration.

The production of outstanding research depends on creativity. Based on interviews with Nobel laureates and the literature on creativity, Nemeth (1997) built a personality profile of the “highly creative” including confidence and independence, a preference for complexity over simplicity, for some disorder, and a tendency to be child-like, though not childish. Play appeared important; even at an age of more than seventy the laureates were described as ‘playing with metaphors from completely different disciplines’ (Nemeth, 1997, p. 70). Csikszentmihalyi (1996, p. 326) supports this view, identifying ‘… a great deal of curiosity and openness’ and ‘an almost obsessive perseverance’ as the central traits of creative individuals. It may seem paradoxical that the presence of child-like curiosity and determination in adults, while supporting the creativity that is the foundation of innovation, could result in some degree of patronising treatment from non-researchers.

While there was nothing in the opinions expressed by researchers in the interviews to suggest naivety, it was notable that aspects of their physical environments, and physical appearance seemed calculated to claim a “special status” separate from the norms of business organisations. For example, the offices of the commercial personnel seemed designed to convey an impression of ordered success. The offices and conference rooms were interviews took place were uncluttered and conformed to a clear organisational standard of orderliness with consistent furnishings and interior decoration. The office spaces were unremarkable in their appearance and appeared inter-changeable. A striking contrast existed in the furnishings of the researchers.
The following excerpt from the notes I made describing one researchers’ office environment directly after the interview illustrates an extreme case:

Most of the external wall is glass with a view of trees, grass and the car park. Interior decoration is decidedly non-corporate, life size cardboard cut outs of movie characters, fake and scatological adverts are stuck to the wall. Instant coffee he has to supply and make himself. Would most business environments accept the eclectic room décor, including real weapons? Does it represent an assertion of belonging to a specially gifted and different category of employee?

Other research environments featured the constant hum of computer servers perched on the end of conference room tables with handwritten signs taped to them saying, “Never move or turn off”. Mismatched, old, and stained chairs were a common sight and in one case, a wall calendar was at least five months and possibly more than a year out of date. Shabby and cramped conditions appeared to characterise the offices of researchers interviewed, including those in government funded laboratories and small start-up companies as well as on university campuses. While the research offices I observed consistently appeared disorganised and shabby, in contrast to the business offices designed to impress, one informant had reported the opposite arrangement. A commercially oriented engineer from the Biomedical Graduate CRC had commented that his commercial group worked in cramped conditions while the scientists were located in the area with, “embedded coffee rooms …wall offices and lots of glass.” I returned to this informant to collect more information about use of the workspaces. The second conversation explained the inconsistency with the research environments I had personally observed. As has been typical for CRCs, the scientists were the first members of the organisation. They had moved as a group into office space selected to impress potential investors. The commercial members, hired later, took up residence in available, but less attractive space. However, the commercial engineer, when asked an open question “How did the scientists use their space?” responded that there was “surprisingly little order or neatness.” He added that if you lifted up the fume hoods you found a “pig sty” and that the commercial members of the organisation referred to visiting the research area as “going to visit the sandpit.” It is arguable whether research environments are designed to show the application of different standards, or the unimportance of outward appearances of prosperity. However, one unintended effect may be to reinforce commercial perceptions of researchers as juvenile.
The physical spaces occupied by the researchers interviewed appeared to be composed of cast-off furnishing, resulting in a “hand-me-down” approach to interior design; unlike the impressive and coordinated settings that the commercial informants had chosen to support their actions. Upon graduation, business and commerce students buy suits, move into corporate offices and leave university life behind. Maybe researchers never do. In choosing a research occupation, they continue to be part of an occupational culture which values, and rewards successful exploration and publication above all other activity and embraces great diversity in dress, appearance and office decoration. This conjecture is supported by Dubinskas’ (1988) ethnography of cultural contrast and conflict in early genetic engineering firms. He interpreted similar differences in the furnishings and other visual boundary markers used by researchers and business executives as indicative of the distinctive knowledge bases and practical expertise of each group. Furthermore, Dubinskas also reported managers speaking of biologists as immature and linked this to occupational self-image.

Managers see themselves as rather unproblematically adult and fully formed human beings. …Their advances involve getting “more” of what they already have – responsibility, authority, prestige and financial reward. … The biologists, on the other hand, characterise their own development process as continuous throughout their lives. … This growth should never come to “completion.” The growth is also located in the intellectual realm, the realm of productive “ideas,” which are less valued as things-in-themselves by the managers (Dubinskas, 1988, p. 200).

Consequently, inter-occupational tension based on perceptions of researchers’ child-like behaviour is not limited to the four Australian CRC organisations I interviewed during 2005, and the antecedents and consequences maybe far-reaching. Investigation of the foundations of this inter-occupational perception follows, referring to the complementary roles of exploration and exploitation in organisational learning within the CRCs. I argue, through examination of "explore, publish and share" and "focus, plan, execute" themes arising from the interview data, that these mutually supportive roles in organisational learning are largely performed within occupational boundaries in CRCs. Consistent with theory (Lamont & Molnar, 2002) the impact of this role compartmentalisation between two groups in the CRCs, combined with few administrative or other groups to act as a buffer, is a heightened awareness of occupational difference and negative judgements of the other, competing group.
Building upon commercial members’ identification of research exploration as “child-like” I will explore other evidence for occupational patterns of exploration or exploitation contributing to the frustration and tension evident in inter-occupational relations in the CRCs.

6.8 Occupational Approaches: Exploration and Exploitation

Application of Progressive Comparative Methodology (Fitzgerald & Hayes, 2006) to the interview data assisted in the identification of two approaches to, or patterns for activities in commercialisation. Research activities are characterised by the interviewees as exploration. Novelty, creativity, the autonomous pursuit of what is interesting to the individual researcher and the importance of publication to ensure free sharing of discoveries with research peers, all characterise the exploratory mode of operation. Exploratory research activities balance commercial exploitation activities, oriented towards the selection of a single, selected option. The selected option is then refined by commercial communities through the reduction of variability, and risk and by increasing its reliability. Identification of exploration and exploitation activity patterns in reference to organisational learning exists, for example:

Explosion includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution (March, 1991, p. 71).

However, occupational tensions may be exacerbated by the compartmentalisation of tendencies towards exploration or exploitation within occupational boundaries in CRCs. Furthermore, unexpected results are generally bad news for managers, representing deviations from plan that need to be controlled. In contrast, surprising results can be the source of potential greatness for scientists; the role of serendipity in breakthrough scientific discoveries is acknowledged and documented (R. Roberts, 1989).
Members of both occupational subcultures described their work, and the work of the other community by reference to concepts and metaphors of exploration or discovery, and exploitation or focus. For example, in contrasting his activities to refine a solution with researchers’ patterns of continual exploration a commercially oriented engineer offered:

“As an engineer what I try to do is [get the product] down the funnel. The way science works is like dropping stones into a pond where you get ever and ever more and more ripples. And each ripple makes more and more ripples. I need to get the information into a funnel because I have to get a product out.” (Commercial Engineer, Biomedical Graduate)

A researcher from the same organisation offered confirmation of the differing occupational work models and offered insight into the personal impact of the divergent approaches:

“I think formalising the requirements is something that people in commercialisation do but people who develop technologies don’t do. They always want to make it better; they get a little bit upset if you try to nail them down to a particular specification. They like things open-ended. Whereas in commercialisation the point really is to make it closed-ended before you start, or at least very close to the beginning, and then to work that plan. If you’re used to working in the open ended scheme when someone comes along and tries to make you do it in the closed way you begin to feel like you’re being micro-managed. You feel like you’re being forced to justify what you do sometimes, and that can be quite a threat.” (Researcher, Biomedical Graduate)

In addition to all informants consistently identifying exploration as representative of research activities and exploitation actions as typical of commercial occupations, tension arose when members encountered the opposite work mode in each of the CRC organisations. For instance, a researcher reported, “a clash occurred” when researchers and commercial people worked together in a group:

“The commercial product managers wanted to focus on one approach only and pin it down into absolutely, no divergence whatsoever. So you had one [research] group where it was expanding, new ideas, and one [commercial group] that wanted to pull down as tightly as possible to “OK, but what’s the product going to look like? We have to stick to these specifications; we’re not going to deviate any more.” And so you had that difference of approach.” (Researcher, Biomedical Graduate)
In the current Biomedical CRC, a manager of researchers compared the insistence of commercial partners for staying on a selected path with the research groups’ willingness to investigate other options:

“The manufacturer [CRC industry member] would probably take a view which says, “No, you embrace the culture,” of what they’re focussed on developing. There’s very much a view from the manufacturer that they’re on a trajectory of a particular technology. In our view that technology is fundamentally flawed. But getting them to actually recognise that and consider another way of doing seems to be extraordinarily hard.” (Manager, Biomedical Current)

A researcher in the IT Graduate CRC who had moved into an executive management position revealed a continued joy in exploration, and being associated with discovery:

“I never, ever, even to this day, have lost an interest in innovation and an ability to inject ideas and as I result I’m probably on about forty per cent of the patents that the centre has created. … I enjoy that very much. It’s a way that I can spend many useful hours thinking about “What if” kind of questions, which I love to do.” (Researcher, IT Graduate)

Further, in the IT Current organisation, although only in its second year of operation, a manager noted:

“We have an over-researching question that we need to get a hold of which is that the researchers want to keep doing research as opposed to cutting it off and saying “This is good enough to use now. I tend to tackle that through user testing … inside a number of environments and if people think it’s at the stage where it’s ready to go then we start looking at moving it along.” (Manager, IT Current)

The findings above illustrate stable patterns of difference in work patterns in the four organisations, supporting the thesis that occupational subcultures exist in hybrid research-industry organisations and can influence commercialisation outcome. Furthermore, there were no changes in opinion regarding the existence of, and forms taken by, the disparate occupational approaches to innovation within the retrospective interviews with members of graduate CRCs, or over the three longitudinal interviews conducted with the participants from the current CRCs. Researchers were oriented towards exploration, publication and sharing, while commercial occupations emphasised the need for focus, planning and production
related tasks. The participants viewed the impact of these fundamental differences in occupational approaches to commercialisation as negative. Misunderstandings, miscommunication and perceptions of lesser levels of commitment were some of the outcomes associated with the division between exploration and exploitation roles. This leads me to conclude that the answer to the third research question (p. 64) is that while CRC members understand that contributions from both research and commercial occupational subcultures are required for successful commercialisation, they perceive the differing assumptions, values and norms as impediments to efficient progress.

I will now review the impacts of orientations towards exploitation and exploration in each of the organisations, in support of this conclusion.

### 6.8.1 Evidence from the Biomedical CRCs

Of the four organisations investigated in the research, the Biomedical Graduate CRC stood out as experiencing most occupational conflict. Biomedical Graduate informants reported widespread and long-lasting conflicts related to difficulties in co-ordinating the two occupational approaches. The research and commercial group members both made disparaging assessments of the activities of the other group. A commercial engineer attributed product delays to a “problem of too many scientists playing around” and identified exploratory behaviour as generally problematic:

“They didn’t like repeating anything. Scientific experiments, once they had done it once that was it and there was no longer any interest in it. Now to turn it into a commercial product you need it repeatable. So yeah, there was a lot of head-banging at that stage.” (Commercial Engineer, Biomedical Graduate)

A manager in the same organisation echoed these sentiments, viewing research exploration of all options as evidence of inadequate preparation and planning:

“They see themselves as explorers and who knows what’s around the next corner? Well, let’s start making some plans about what might be around the next corner… and plan for things not going as we hoped.” (Manager, Biomedical Graduate)
He added that researchers needed to be at risk of losing their jobs before they would focus their activities to meet commercial delivery dates, and contrasted research perceptions of value and risk with those of the commercial world:

“Scientists think once they’ve discovered the original principle or something, that’s it! It’s just down to business to make it. If you look at a drug, the discovery part of it is vital and necessary but it’s microscopic in terms of the investment and development that goes in, and arguably risk as well. We always say that the early stage of drug development is the risky stuff but it’s cheap as well. The really risky stuff is when you’ve already spent three hundred million on a drug and you’re going to do two or three trials that cost a hundred million each and they might fail. It’s still fifty fifty, that’s really risky.” (Manager, Biomedical Graduate)

The methods advocated to solve a product prototype problem strikingly illustrate the distance between the two approaches and the impact of this gap. In counterpoint to managerial emphasis on getting to market quickly, researchers viewed managers’ attempts to restrict the scope of inquiry, and focus on obtaining a specific outcome by a specific date, as simplistic:

“I moved from being among all scientists to … working in a hierarchy that was all commercial people and it used to frustrate me that some of the issues that I knew as a scientist were very complex, the managers who were not necessarily scientists had an innate belief that these things could be engineered rather than needing any research. It was just “Tell me how much you need and how many people and woof!” (Researcher, Biomedical Graduate)

Managerial attempts to find a quick, satisficing solution to what researchers viewed as a fundamental science problem were condemned as “diminishing the science.” When asked to elaborate a researcher explained:

“They would move scientists from more speculative projects that were to do with enhancing the technology and widening the platform of the technology into very specific things to meet product requirements. … it was looking at engineering and technological ways of making what we have do [suffice], rather than looking for the quality solution.” (Researcher, Biomedical Graduate)

In preventing research personnel from using the tools associated with their underlying scientific discipline to find the answer to a problem and simultaneously increase the total understanding of the field, the managerial exploitation focus clearly
conflicted with research values of exploration. This illustrates the difficulty both groups can encounter. The problem-solving approach that may seem “natural” to one group may be anathema to the other, and consequently fuel negative perceptions between both groups.

Researchers reported that the business member of the Biomedical Current CRC in effect controlled the hybrid organisation. One researcher reported that he felt his research organisation was “used” to provide “independent certification” of the technologies produced by the commercial member, did not consider itself to be an equal partner, and was not truly considered by the business member to be a source of innovative ideas. Exclusion from participation in exploratory activities and performing a supporting role to exploitation activities clearly rankled:

“The CRC is meant to be government taking a view that says, “Well perhaps we should invest in some of this visionary thinking and see what can come of it?” More recently though it’s a case of “How much can we get back from it?” And that sometimes stifles good science. … It’s not about expense minimisation, it’s about revenue generation.” (Manager, Biomedical Current)

This respondent identifies a shift in what he viewed as the purpose of government funding, that is, from visionary exploration to commercial exploitation, and like the researcher in the Biomedical Graduate CRC, judges this detrimental to both the practice of science and the autonomy of researchers.

A researcher in a government funded research institute which is a member of the same CRC was delighted that the discoveries made by the organisation were being converted into, “things that you know are going to be useful.” While appearing to experience less goal conflict with the business partner, the researcher reported concealing the time researchers spent in exploratory, pure research from the research institute’s accountants. The commercial and research groups within the organisation operate with different priorities and different views of what counts as work. The researcher was aware of the incongruence of the values of the two occupational subcultures, and had coped with it by squeezing discovery time for new projects into the official project plans for approved projects. He explained:
“It’s difficult to budget the discovery time in and yet everyone knows you have to do it. I don’t think we’re very good at doing it. We have detailed project plans for each project and the discovery time gets done before we actually have the official project plan on our books. It’s slotted in between the other projects that were meant to be running.” (Researcher, Biomedical Current)

The research group in that particular institution has since gained formal acknowledgement from their financial group that “discovery time” is a valid work category on the time sheets completed by researchers. Now research norms in that institution are visible to and accepted by the accounting group. Discussions during the thesis research interviews regarding the misalignment between researchers’ exploratory activities and accounting administrations devoted to measuring exploitation progress provided the impetus for this organisational change. While the amount of discovery time negotiated is lower than the fifteen per cent desired by the research manager, it represents an acknowledgement and acceptance of the legitimacy of research exploratory activities that was absent previously:

“We have built in some discovery time though not up to fifteen per cent, and not for everyone as yet. We have many projects that should finish this year and are determined that we start new ones at a slower rate than we finish old ones so that we have the capacity for adequate discovery time.” (Researcher, Biomedical Current)

The situation described above, where measurement of exploitation activities are taken as primary indicators of commercialisation, links to another significant theme arising from the interview data, that of time. The commercial members interviewed displayed an orientation towards short-term goals, in monochronic pursuit of single projects with high priorities placed on pace and punctuality. In contrast, researchers (with one exception) identified themselves as likely to adopt a polychronic approach, pursuing several projects at once, to be less concerned with delivery dates than with the novelty of what they were discovering and the necessity of gaining a thorough understanding prior to publication. Whilst temporal orientations are an interesting cultural construct that clearly defines occupational subcultures, the scope of this thesis did not allow for deeper investigation into this construct. Instead, this thesis focuses on inter-occupational argumentation and innovation management processes as boundary objects. Nevertheless temporal orientation of occupational subgroups is
recognised as a rich and potentially significant topic for further (post-doctoral) research.

Another interesting aspect of the Biomedical Current CRC is that a process used by a commercial member organisation in order to comply with regulatory and reporting requirements in the biomedical industry appears to play a role in bridging occupational cultures. In addition to providing audit trails, this process appears to assist the transition from exploratory to exploitative activities in the innovation process. A commercially oriented engineer described the transition from exploration to exploitation as “a grey area, not a single point” and the five-stage process performed both technical and ritual functions in marking the passage of a new product from exploration to production. The foci of different occupations were accommodated through the early involvement of all stakeholders, using 5th generation, or network style commercialisation process (Chesbrough et al., 2006; Rogers, 1996), followed by a five stage process to semi-democratically manage the “grey area” where control moves from research to commercial groups within the company. The managerial implications of this approach to managing occupational subcultures in commercialisation are discussed in full in the final thesis chapter, 9 Implications and Recommendations.

6.8.2 **Evidence from the ITC Sector CRCs**

Displays of occupation specific patterns of exploration and exploitation were also evident in the two CRCs operating in the Information Technology and Communications industry sector. However, while sharing some of the challenges in managing the transition from exploration to exploitation spheres of innovative activity, the researchers’ and commercial members’ comments on this topic were less emotive and less frequent than in the biomedical CRCs. Within both IT CRCs, researchers sought the opportunity to participate in commercialisation activities as much for the perceived security provided by CRC funding to engage in long-term research as for any expectation of commercially valuable outcomes. The attraction of seven years of funding through participation in a CRC is illustrated by reference to the comments of members in the IT Graduate and IT Current organisations, which are then evaluated in terms of motivation to engage in commercialisation activities.
A researcher who had been part of the IT Graduate organisation spoke of considering three potential career paths after leaving the CRC:

“One was to continue where I am now, [small start-up organisation] another one was to go to an academic environment and the third one was to start my own business and once I make all the money (laughs) invest that into my research, set up a lab. I think this last one was ideal because it would give me freedom to do whatever I want to do and I just have to find the way to implement that. …I’m dreaming about something which would include less commercial commitment so that I would have many more opportunities. So, this is what I would like to explore more. So I can say, “I’ve done that, alright it’s interesting but it’s finished so I want to move to something new (laughs).” (Researcher, IT Graduate)

The attraction of exploration, novelty and autonomy in choice of subject and method of investigation are evident in his words. His motivation to start a business was to produce an ideal research environment; well funded and without commercial commitments. The interviewee’s laughter reveals his awareness of the apparent contradiction between wanting to start a business in order to avoid commercial commitments. Later he added, “My dream really is to make myself free from this, the capitalist who stays behind your back and tells you whether there is a return on our investments. I really want to get away from these institutions.” For researchers the appeal of being part of a commercialisation group may lie in funding or other conditions that support research activities, and have less to do with commercialisation outcomes per se. A researcher from the IT Current CRC supports this interpretation, contrasting the difficulties of attracting research funding in the form of a four year Australian Research Council (ARC) grant with the higher success rates for applications and a guarantee of seven, and potentially fourteen years funding provided by participation in a CRC.

"While I was a PhD student in the school we always hoped that we had a centre so we'll have long term funding support and we don't need to shop around for short term funding like ARC because that is at most four years. You finish and if you're not so lucky you have to change your research focus significantly. But the funding for CRCs is usually for seven years, if you're doing a good job in your management of the project, you can actually say, "Well, I'm safe for seven years." (Researcher, IT Current)
Later comments by the same researcher reinforce this pragmatic approach, embracing exploitation of research outcomes as a path to maintaining, or even increasing exploratory opportunities, in describing the value of being able to present their active CRC projects to the Management Board of the IT Current CRC:

“That has now broadened our chances of funded, commercialised research because the government and the CEOs of some large companies on the board are the potential users of the research outcomes. …If we didn’t have the CRC platform there is no chance for me as a researcher to talk to, to have so much time available and to have senior managers listen to me. No way! So it’s great.” (Researcher, IT Current)

In conclusion, participation in CRCs appears attractive to researchers not for any innate interest in seeing practical applications result from their research discoveries. Instead, the relative ease and longer duration of funding from governmental sources for commercialisation projects, and the availability of additional funds from industry seem to offer improved conditions for researchers.

Members of the IT Current CRC also revealed that the boundaries between exploration and exploitation activities are thick and strong. A manager described the response of universities in the CRC when a commercial manager from a small company proposed a project, conducted independent research outside the auspices of the CRC, and then presented a prototype to the CRC Board for funding:

“There was some interesting tension as to why the private sector was driving this, building a box in an area of scientific interest. [The manager conducting the research] is a very interesting character in terms of private industry. He’s got some of those academic curiosity challenge drivers as well as finding something that makes business sense or generates revenue. That’s one where I think it’s going to be a good result for the CRC, but I’m still yet to see real integration between the university and the private company on that one. (Manager, IT Current)

The researchers had adapted to working to commercial project plans and directed their research efforts into areas of potential economic gain. However, their reaction to a commercial person crossing into the research domain and engaging in exploratory activities without the permission or involvement of researchers supports my assertion that the boundaries between commercial and research occupational subcultures, and their ownership of exploration and exploitation activities are strong.
March (1991) states that exploration activities need to balance exploitation activities in the development and use of knowledge in any organisation. In modelling the impact on organisational learning of implicit, (based upon organisational forms and norms), and explicit choices (involving financial and strategic choices) of the allocation of resources to exploration and exploitation activities, March (1991) concludes that ‘maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity’ (p. 71). Hybrid industry-research organisations present a mainly dichotomous organisational setting; two occupational cultures separately embed the functions of exploitation and exploration, with few individuals from other occupations to act as a buffer between them. The evidence from the interviews clearly supports March’s summary of the two modes of working:

The essence of exploitation is the refinement and extension of existing competencies, technologies and paradigms. Its returns are positive, proximate and predictable. The essence of exploration is experimentation with new alternatives. Thus, the distance in time and space between the locus of learning and the locus for the realisation of returns is generally greater in the case of exploration than in the case of exploitation, as is the uncertainty (March, 1991, p. 85).

Therefore, it can be said that all informants agree that part of the tension between the two communities is attributable to the differing priorities placed upon novelty, discovery and free sharing of information contrasted with reliability, predictability and protection of intellectual property. The research participants were unimpressed by management attempts to circumvent their generation of knowledge in the underlying research discipline with satisficing solutions intended to ensure rapid exploitation of market opportunities. In addition, some commercial members of the CRCs appear to have difficulty in acknowledging the role of creativity and apparently unfocussed research in making the discoveries that provide the genesis of valued innovations. Members of commercial and research occupations appear generally content to follow their separate, fulfilling paths of activity. As stated by a commercially oriented engineer:

“In my career I have found that generally engineers don’t envy scientists and scientists don’t envy engineers. They’re quite happy you know that “I make products, I don’t investigate ideas.” And scientists go “How boring! All you do is make products, you don’t think about things.” There’s not much conflict, there’s a nice separation there. (Commercial Engineer, Biomedical Graduate)
However, as the quote suggests, tensions can occur when either research or commercial occupational communities apply their own norms to the work of the other community when combining their work in commercialisation activities. Research with potential for exploitation by industry, and which consequently attracts external funding can command the attention of researchers. On the other hand, this is mainly due to its value in supporting continued exploration activities.

6.9 Summary of Findings for the First Two Research Questions

This chapter presented and evaluated the evidence for members of the Australian CRCs examined recognising commercial and research occupational subcultures within their organisations. Informants perceived differences between the two groups to be more than superficial. Adverse impacts upon commercialisation resulted from the challenges of working in contested territory between the two groups’ norms and assumptions. Boundaries between research and commercial occupational subcultures were determined to be highly salient, imperfectly permeable and durable.

As described in the literature review chapter 4, page 45, in temporary, hybrid industry-research organisations, innovation activities are increasingly conducted across organisational and occupational boundaries. In addition, authority structures can be unclear (Barringer & Harrison, 2000; Borys & Jemison, 1989). Having explored underlying beliefs held by research and commercial occupational subcultures regarding the relative value of exploratory and exploitative behaviours, one management challenge inherent in the operation of hybrid research organisations is now considered in depth: that of the debating norms of research and commercial occupational subcultures. Specifically, members of commercial occupations can interpret ritual dissent, considered a normal and constructive mode of interaction by members of research occupations, as a sign of conflict and an issue that needs to be controlled. The next chapter explores the topic of occupation specific argumentation styles as a barrier to commercialisation and in doing so contributes to the disciplines of innovation management and argumentation.
Chapter 7

Argumentation as an Occupational Norm and Commercialisation

Referring back to the grafted tree metaphor for CRCs (Figure 6.1, page 96), the presence or absence of post-graduate qualifications acts as a visible boundary between the two occupational groups. The two boughs of the plant represent proclivities towards either exploitation or exploration; they provide the underlying support for the visible differences, and link to occupational assumptions and norms. The remainder of this chapter considers a “leaf”, patterns of inter-occupational debate in commercialisation.

I argue, based on the interviews with scientists, engineers and managers that the styles of argument used in occupational groups within hybrid industry-research organisations may act as a barrier to commercialisation. My analysis of different argumentation styles extends existing research into occupational norms for debate to include innovation, commercialisation processes and the context of triple helix organisations.

7.1 Inter-Occupational Argumentation

In hybrid industry-research organisations, argumentation, defined as the action or process of reasoning systematically in support of an idea, commonly occurs in groups composed of more than one occupation. For an extensive review of argumentation theory see Sillince (2002). Rational or scientific argumentation uses logical reasoning about competing ideas, for an extended period, until the topic has been exhaustively analysed. It is important to distinguish between the form of
argumentation identified as rational by Sillince (2002) and the rational school of
epistemology. Rationalism refers to the Cartesian approach to the philosophy of
knowledge, based upon the use of logic and mental constructs to deduce truth.
Rational argumentation, as referred to in this chapter, is not limited to Cartesian
notions of truth and knowledge. It is equally applicable to empirical approaches
based upon induction and sensory experiences (Nonaka & Takeuchi, 1995).

Far from being an outmoded form of rhetoric at risk of extinction, scientific
argumentation plays a vital role in the creation of knowledge. Programs to measure
and increase the teaching of argumentation in school science are being implemented
in the UK (Erduran, Simon, & Osbourne, 2004). Although scientific and academic
groups are skilled in and accustomed to using constructive dispute to produce
creative ideas and outcomes, occupational norms that proscribe dissent may restrict
the effectiveness of these techniques in cross functional groups. Conversely, the
value of minority opinions and constructive dissent in increasing group creativity
while guarding against “groupthink” is well documented (Nemeth, 1997). However,
members of business cultures, which in the main value cohesion and conformity
(Pech, 2001), may view signs of disagreement between researchers as alarming and
predictive of failure.

Notwithstanding the benefits of dissent for testing and improving ideas, scientific
forms of argumentation have been identified as poorly adapted to public debate of
trans-scientific social issues such as global warming (Ziman, 2000). The challenges
of engaging in argumentation across the boundaries of national cultures (Liu, 1999),
and rhetorical traditions (Dolinina & Cecchetto, 1998) have also been acknowledged.
The use of language, dialogue and argumentation is an occupational culture
construct, policing acceptable communication within the group. As McKerrow noted
(1980, p. 31):

… communities are typified by the specific rules which govern argumentative behavior,
by social practices which determine who may speak and with what authority, and by
their own “display” of these rules and social practices in response to challenges from
within and outside the community.

Furthermore, McKerrow (1980, p. 31) asserted that when individuals from two
communities with different standards for judging the strength and appropriateness of
arguments deliberate, the choice is to select one set of argumentation standards or "face a contradiction that cannot be easily resolved." However, little attention has been directed to the potential impact of conflicting norms for argumentation on the commercialisation phase of innovation in either traditionally structured, or hybrid industry-research organisations.

7.2 Argumentation as an Occupational Norm

... we wonder if all of those lovely, extrinsic rewards will cause us to become arrogant, overconfident, or lazy, or – worst of all – to stop arguing. We believe the quality of our work will suffer if we stop bickering and are left with only our optimism (Sutton & Rafaeli, p. 127, in Frost and Stablein (eds), 1992, Doing Exemplary Research).

Scientists, engineers, and managers from government and private sectors described distinctive patterns of argumentation as typical of research and commercial occupations. Descriptions of scientific and research group debates were consistent with earlier reports (Nemeth, 1997; Ziman, 2000). Specifically, restrictions on the amount of time allocated for discussion, the likelihood of reaching a clear conclusion and expectations of action as results of debate were very different for commercial and research communities. Both commercial and academic groups agreed that researchers enjoyed debate and viewed it as an important part of their identity. As stated by a scientist, who moved to a management position:

"The important aspect is inquiry into "What's the best focus?" It's not inquiry for the sake of "Let's muck around." And that's often the criticism of science going into commercialisation. Inquiry is a necessary process before you arrive at an agreed way forward. That's very stimulating and something I really, really miss in shifting from that culture ... difference of opinion is part of the creative process."

(Researcher, Biomedical Graduate)

The importance of dissent as a tool to hone solutions through a verbal contest of ideas and as a symbol of scientific identity was evident. When asked if the academic and research members of the CRC enjoyed debating amongst themselves, a public sector manager responded that it was a core part of their professional identity, stating:
“They’ll [researchers] consider [debate] very much part of their reason for existence and if they didn’t have that debate I think they would see themselves as not representing their profession. …. The debate may well air a range of options and different opinions and approaches and thoughts and so forth but it doesn’t crystallise an outcome. And for the private sector all that debate’s good, but if it doesn’t bring you closer to an absolute outcome, an absolute decision, well then all it is, is debate. It may be very worthwhile from the academic point of view but time is money when it comes to the private sector.” (Manager, IT Current)

A commercially oriented engineer supported the view revealed in the above quote, that business communication should be action-oriented and produce a clear conclusion, remarking:

“There were meetings that only scientists used. They had a university common room meeting culture. They would sit and talk about the latest discoveries in the field; it was just a big chinwag. And that was work. Because they were scientists...they'd talk about the latest things in the field and if it didn't relate to the thing I was trying to make I couldn't care less. I used to get dragged along to them occasionally but, operations point of view, meetings to me were a waste of time. I do the communication I need to do as I need to do it.” (Commercial Engineer, Biomedical Graduate)

Similar comments by other participants indicated a clear understanding and acknowledgement of differences, both in the acceptability of dissent and the desirability of reaching a clear conclusion in a specified time. Researchers appeared comfortable with, and even proud of their ability to use “talking as thinking” in a mono-cultural group, in contrast to commercial interviewees who preferred talking to be preparation for action. Comments made regarding time limits for debate suggest that argumentation norms are influenced by different temporal orientations towards pace and punctuality in the two broad occupational groups. Investigation of this possibility represents a potential topic for future research.
7.3 Research Hierarchies and Argumentation

The researchers interviewed generally focused on the function extended argumentation performed in knowledge creation; however several research and commercial interviewees acknowledged that argumentation also played a role in expressing and maintaining a hierarchy among research institutions. The existence of a “pecking order” of organisational hierarchies within the research CRC members was introduced earlier (Chapter 6.4, page 103). Managers reported that universities in the “top tier” preferred to deal with others of similar status and did not give as much time to universities perceived to hold low rankings. The existence of a hierarchy of research institutions and researchers was corroborated by researchers, one of whom explained:

“This is all about the prestige or precedence of the universities who have a pecking order. To collaborate with someone who is below you in the pecking order is going to pull you down.” (Researcher, IT Graduate)

The participating researchers generally described their debates as impersonal, driven by intellectual challenge and focused on reaching the best possible solution, but several research and commercial participants identified extended debate as a vehicle to demonstrate and consolidate academic hierarchies and express conflicts within the research community. The role that “contests of ideas” play in establishing and maintaining a research hierarchy was clear to both research and commercial participants. A researcher in the Biomedical Graduate CRC described his discipline as “very, very tightly hierarchical, very, very efficient, hard nosed, callous, extremely callous, extremely competitive backbiting” and continued to express the view that the hierarchy in research communities was more vigorously contested than that of industry:

“Have you ever been to an international [research] conference where people are fighting over the stakes and seen concession and kind hearted behaviour? It is absolutely back biting beyond belief and beyond anything that Wall Street can turn up.” (Researcher, Biomedical Graduate)
A commercial engineer from the same organisation confirmed the existence of a research hierarchy:

“There was just a pyramid of scientists. Scientists are like that you know ... you get to be a scientist, a senior scientist, a super-super scientist, an extra-super-duper scientist and a king scientist.” (Commercial Engineer, Biomedical Graduate)

Additionally, one manager in a biomedical CRC explained that linkages between universities and hospitals represented “power blocs” in his field, and certain institutions were unable to join a CRC if existing members regarded them as inferior.

The above quotes demonstrate that members of both research and commercial subcultures identify hierarchies within research communities. However, expectations of how a hierarchy will modify debate are very different for research and commercial groups, and present a challenge to communication between managers and researchers in high technology hybrid research organisations.

Researchers are unlikely to be surprised by the description of research argumentation norms. As Schein (1996, p. 236) noted:

Norms become a fairly visible manifestation of these assumptions, but it is important to remember that behind the norms lie this deeper taken-for-granted set of assumptions that most members of a culture never question or examine. The members of a culture are not even aware of their own culture until they encounter a different one.

However, this was not the case for the commercially oriented personnel interviewed for this research; commercial informants described research styles of debate as “chinwagging” and even “atrocious”. A manager in a CRC in the early stages of formation described exposure to research norms as “a revelation”. In hybrid industry-research organisations, commercial personnel may be encountering research or academic forms of argumentation for the first time. What is certainly surprising is that in the multitude of organisational parameters used to explore innovation outcomes (Wolfe, 1994), occupation specific argumentation has been overlooked.

A detailed examination of the challenge associated with inter-occupational argumentation in commercialisation follows.
7.4 Research Hierarchies, Argumentation and Violated Expectations

As substantiated in the previous sections of this chapter, confusion and frustration can result from contact between research and commercial occupational subcultures. Managerial occupational culture features a competition based work hierarchy, in which senior managers act in decisive and controlling ways to express their status (Schein, 1995). Hence, both research and commercial occupational cultures have strong and visible hierarchies, but differ markedly in their attitude to dissent (Nemeth, 1997; Pech, 2001). Members of commercial and research organisational cultures in the CRCs studied recognise a hierarchy of authority in their own, and in the other occupational community. This leads to expectations of similar attitudes towards deference and dissent. However, the norms of the two occupational cultures vary markedly in their use of dissent. Language norms associated with dissent in research and commercial occupational cultures violate initial expectations of similarity built upon a common recognition of occupational hierarchy, as is illustrated in Figure 7.1.

False impressions of similarity, based upon use of a common language, can reduce the ability of participants to attend to the substance of an argument and can lead to suspicion and hostility between members of different national cultures (Dolinina & Cecchetto, 1998). This research has found that members of research and commercial occupational subcultures working in Australian CRCs report frustration and reduced effectiveness of argumentation due to different norms related to the acceptability of dissent. Initial expectations of similarity, built on identification of occupational hierarchies, heighten the impact of these differences. In research communities a contest of ideas builds and sustains the hierarchy; open intellectual dissent is considered normal and constructive. In contrast, dissent is viewed as divisive and destructive in commercial organisational cultures (Nemeth, 1997; Pech, 2001). For example, while briefly acknowledging the opportunities for creativity that can be presented by conflict, Levine clearly views conflict as an expense to be avoided through seeking resolution as quickly as possible, cautioning ‘It is very important to
understand the magnitude of the transaction cost of remaining in conflict’ (Levine, 2006, p.379).

It is not within the design of this research to comment upon whether business or research communities have more pronounced hierarchy. Examining this question represents another avenue for future research. However, both groups operate within hierarchies, leading to expectations that communication within the hybrid organisation will follow familiar patterns. These expectations are routinely violated; first by vigorous debate between researchers when commercial members expect deference, and second by silent acquiescence from commercial members when researchers anticipate intellectual dispute. A commercial manager identified the following instance in which research norms of dissent conflict with those of business:

“The academic world is about critical debate and a lot of people go to [research] conferences to generate critical debate so they stand up and
they expect to get criticism about their work and have to defend it. But if you go to a conference and it's an industry conference it's more about promoting your product and if people were to be critical of it you'd be offended.” (Manager, IT Current)

Supporting the view that criticisms across occupational boundaries are not acceptable, a researcher reported that while criticism of his work by other researchers was a normal part of being a researcher, assessments of his work by managers, and the use of managerial authority to remove him from a project was intolerable and resulted in his resignation:

“For me that was quite a significant impact on my life because just emotionally, that was something I had worked on for a number of years and suddenly I was taken out of this and it was not really fair I thought, and not really based on my value as a founder and as a scientist … I could have avoided the conflict with this person but the methods that he used were just inappropriate and I couldn’t sustain insults and things like that and I just had to respond. Although maybe if I had a different culture and … was not that focused on the company succeeding, if I was focused more on keeping my position then maybe I would behave differently.” (Researcher, IT Graduate)

In a different CRC, a manager reported a similar response from a researcher who had funding removed from his project. Managers from government departments had publicly scrutinised the project, while managers from industrial organisations had held back from the debate. The outcome was the researcher’s resignation:

“… he was a very senior academic and thumbed his nose a little bit by resigning a position on the CRC. The research he was doing wasn’t going to result in something the private sector could take to market. So that’s probably why the private sector weren’t active participants.” (Manager, IT Current)

While both research and commercial groups in the CRCs explored are comfortable operating in their own occupational hierarchies, the two groups hold opposing norms related to the acceptability of dissent, and especially the public expression of dissent. In addition, judgements made by people outside the boundaries of each specialised research community are unwelcome, consistent with the importance of peer assessment within scientific and research communities (Merton, 1957; Ziman, 2000). Managers of organisations that are temporary alliances between research and commercial groups can be perceived as lacking the professional and organisational
legitimacy required to judge and control the work of researchers. As stated in the previous chapter (section 6.6) occupational cultural boundaries in the CRCs, are thick and strong. Both the compartmentalisation of CRC exploration and exploitation activities within occupational groupings in CRCs, and the norm of research culture to reject judgements made outside the research community reinforce occupational cultural boundaries. This compartmentalisation, and the strength of the boundaries between the subcultures is perceived to be an advantage in theory, but in practice an obstacle to commercialisation outcomes, by the informants. The interviewees reported that commercial and research occupational norms challenge each other, even if the contributions from the occupational groups could potentially be complementary. Moreover, rational forms of argumentation in CRCs can pose difficulties for research members who wish to lead cross-cultural groups, but who need the support of commercial members to do so. The next section explores this challenge.

7.5 Participation and Leadership in Cross-Functional Teams

In addition to signalling membership of research or commercial subcultures in hybrid industry-research organisations and constructing a research hierarchy, commercial informants identified the use of rational argumentation as a handicap to researchers assuming cross-functional group leadership. Clearly stating all assumptions and relying upon formal logic to win an argument were viewed as incompatible with the political demands of balancing the needs of multiple public and private stakeholders. As explained by a manager:

“... the current CEO is extremely political in [his] behaviour in order to satisfy the conflicting interests of board requirements or stakeholder environments vs. scientific requirements. Getting a scientific person to step into that role and try and manage is near impossible. [laughs] That’s what they’ll try and do. They’ll get in there and say, “I’m just going to be straight.” And of course you need to be able to balance those two conflicting worlds.” (Manager, Biomedical Current)
The manager was quick to praise the skill of scientists and the quality of their logic and reasoning, but continued:

“…there is no question they use logic and reasoning to rule the day. That won’t necessarily work in a political environment where one of the conflicts would come up is his employer is sitting around as one of the stakeholders... But he’ll keep going back and use logic and reasoning as opposed to political processes.” (Manager, Biomedical Current)

Some of the interviewees managing research groups clearly understood that engaging in scientific argumentation could alarm industrial members of the CRC. After saying that he enjoyed engaging in rational debate with other experts in his field, a researcher volunteered:

“I’m just conscious that if I’m having a debate with scientists, even scientists from [industry member of hybrid research organisation], I’m happy to be quite open. Whereas if I’m having a discussion with the business people from the company then I’m going to be much more careful in how I say things so as not to overly worry them about things which indeed are a very small worry, but could be taken out of context.” (Researcher, Biomedical Current)

Consequently, the style of argumentation employed by members of research or commercial occupations does more than identify group membership. It can impede communication across occupational subcultural boundaries. Furthermore, the interviewees revealed that occupational membership, not organisational affiliation, was the source of differing norms of argumentation. Therefore, argumentation repertoires represent another source of the occupational subcultural difference exhibited within the recruited CRCs.
7.6 Participation and Occupational Subcultural Boundaries

Participation in extended bouts of rational argumentation was reported to be restricted to members of groups involved in knowledge creation, whether located in academic, public or private sector organisations. Interviewees spoke of extended and heated, but congenial debates occurring between researchers while commercial representatives present did not participate. Individuals from non-research groups only became involved to stop the debate if they thought it had gone on for too long. A public sector manager described the motivations of business and government representatives present during the debates as follows:

“Private sector, their role tends to be very vested interests, hence narrow focus and short and sharp, not bringing in a whole range of otherworldly thoughts into the process but short, sharp and focused. From the government perspective, the government input is more generalised than the private sector, whether it’s going to be useful from a government perspective. Not as focused and as to the point as the private sector but still somewhat focused relative to what the academic debate might be.”

(Manager, IT Current)

There was general agreement among the informants that research debates were closed to commercial CRC members, indicating that styles of argumentation may help to create and reinforce occupational boundaries. Tolerance of discussions without time limits and with ambiguous outcomes was identified as an important difference. When asked if rational arguments reached final and lasting conclusions a manager commented:

“Well sometimes they do. Sometimes they just peter out in the context of “Yes, there’s differing opinion on the subject” and if there’s no categorical resolve well then everyone can go back to their corners agreeing that there’s differing opinions which could be revisited at a later date.”

(Manager, IT Current)

The argument repertoires reported are consistent with the norms of scientific argument, which include a preference for a written format, a well-informed audience, no imposed time limits and little expectation that a “Yes” or “No” conclusion will be reached to support a particular course of action (Ziman, 2000). On the other hand, business decisions have been reported to be based upon patterns of preparation that
do not conform to the typical pattern of argumentation used in research communities (v. Werder, 1999). Barriers to communication are erected through each group’s use of occupation-specific forms of argumentation, and feelings of frustration are created. Consequently, argumentation norms represent one aspect of occupational subculture identified in the four CRCs as having a negative impact upon commercialisation outcomes. The following section provides evidence and analysis to substantiate this assertion.

7.7 Occupation Specific Argumentation as a Barrier to Commercialisation

In addition to functioning as an occupational identity construct, rational argumentation may constitute a barrier to commercialisation through impeding communication. As a scientist explained:

“The clash occurred where …the mode of working within the culture of science is one that’s driven by inquiry, which is driven by brainstorming. The commercial product managers wanted to focus on one approach only and pin it down, no divergence whatsoever. Even the mode of discussion, conversation, engagement, was so different and the commercial guys found it quite threatening and kept saying, “Stop arguing!” … But it’s viewed as the dysfunctionality of the [scientific] group, and sort of a threatening aspect. And a couple of times where I’ve sort of gone into “science mode” of really wanting to understand “Why and how”, has been seen as threatening. Here as well [referring to new employer].”
(Researcher, Biomedical Graduate)

A manager from the same CRC offered the following rejoinder when asked about the need for scientists to engage in rational argumentation to identify the best possible solution:

“I generally think that there is a, sensible way forward with a number of options that you can discuss but you should be aware of the options beforehand. And the thing is scientists always say, “You don’t know,” and therefore just stop planning for it, which does drive me nuts. … And that’s not really thinking far enough ahead. And that I’ve seen many, many times, that scientists focus on the next few experiments, and being completely unable to handle uncertainty and complexity which is odd given that’s what they should be doing, and I think that is what business does all the time. If you haven’t told somebody something might go
wrong and it does, it might be blindingly obvious to a scientist but if you haven’t told your supporters and investors of the possibility then they are certainly going to see vigorous debate as a failure.” (Manager, Biomedical Graduate)

Researchers recognised the value and complementary potential of contributions from both research and business cultures, but saw managerial language norms intruding on the professional judgements of the “correct” way to conduct research, and degrading the quality of work produced. For example:

“And that difference in culture, the way a scientist will approach a problem is to look at all the possibilities and then choose, and pursue a particular path. The way these guys were doing it was choosing the path and not deviating from it and just going down further and further into that. Now both of them are absolutely constructive because you have that broader engagement to come up with a better solution that you then feed into the very necessarily so, straitjacket type focus. … What that did then, by quelling that inquiry, it actually reduced the standards. The sort of consensus approach reduced the standards of work created. There was a mediocrity that came into the work. It was very interesting, an absolute culture change that occurred.” (Researcher, Biomedical Graduate)

From the perspective of the researchers, attempts by business people to limit debate were dismissed as “micro-management” and indicative of a desire to “dictate” technical solutions to problems they were not qualified to address. Researchers reported dismay and distrust upon hearing business people publicly announce project timeframes based upon what they viewed as a naively optimistic view when dealing with non-routine discovery work; that everything would run to schedule. Both commercial and research informants reported business people viewing rational argumentation as a sign of occupational dysfunction, evidence of inadequate forward planning, or suggestive that the proposed solution will fail.

At least three points emerge from the previous discussion of inter-occupational argumentation. First, argumentation styles can act as occupational and subcultural norms. Second, the use of distinctive occupational argumentation repertoires may not facilitate communication in cross-functional meetings and third, argumentation style may influence perceptions about project statuses and likely outcomes. Undoubtedly, the diverse forms of argumentation favoured by research and commercial occupations provide a sense of group identity and are suited to their differing tasks.
and organisational environments. However, based on the second and third points listed above, different argumentation styles may reduce the ability of inter-occupational contributions to commercialisation to be accepted and recognised as constructive.

7.8 How Can Research and Commercial Groups Talk To Each Other?

Argumentation patterns typical of commercial and research groups reveal their occupational values and assumptions. In commercial settings action and results are valued, particularly as focus on speed as a competitive strategy has increased over the past fifteen years (Vinton, 1992). This leads to argumentation patterns favouring quick decisions oriented towards taking action to achieve short-term organisational goals. This commercial argumentation is not easily reconciled with scientific values of accuracy and thorough understanding. Furthermore, popular management texts praising “strong” business cultures that display consensus and conformity (Pech, 2001) may have exacerbated perceived differences between the two groups’ use of argumentation, contributing to commercial perceptions of scientific argumentation as an occupational and organisational problem.

Research or academic styles of argumentation are characterised by vigorous dissent to create and continuously improve ideas and are not timed, while business debates are reported be action oriented, timed and managed to a definite conclusion. In commercial groups, dissent may be perceived as a threat to group cohesion, group hierarchies and the efficient execution of business plans. Conversely, members of research groups report enjoying intellectual dissent, consider it to be constructive and value it as a key part of their professional identity. When the groups are separate, they can follow their own norms in parallel. However, when combined in cross-functional teams, encountering seemingly foreign standards for debate can create frustration and may jeopardise commercialisation outcomes. Members of each community generally regard the debating norms of the other group as unusual and an obstruction to equal participation (even to the extent of applying labels such as “dysfunctional”), creating barriers to communication and commercialisation. At the
same time, members of both groups maintain their occupational subcultural boundaries and identity by continuing their distinct argumentation style in a combined forum, even when doing so impedes communication.

The argumentation rituals used by research and commercial groups may reflect their underlying reward systems and motivation towards producing knowledge or making money. Mutual conflict exists between business pressures for speed and punctuality and research emphasis on thorough understanding to protect and enhance scholastic reputations. However, the different forms and norms of debate and rhetoric fit two key roles in innovation: imagining the as yet non-existent product or service and making it concrete. Scientific or rational argumentation plays a complementary role to business modes of debate through the creation and testing of ideas vital in the early stages of the commercialisation process. Focusing on a specific form of a new product or service, and organising the team to fund, test, and manufacture in volume to meet set deadlines provides the corresponding applied role.

When viewed from the traditional, integrationist perspective of organisational cultural research, hybrid industry-research organisations face the challenge of operating within an organisational cultural paradox; the beliefs, values and assumptions held by groups within the organisation are seemingly contradictory and yet valid. The divergent bodies of knowledge and skills that make the parties attractive to each other, and provide reason to collaborate, simultaneously create difficulties in communication and cooperation. However, recognition of the dominance of the differentiation view of organisational culture in hybrid industry-research organisations may allow managers of innovation to resolve the apparent paradox; this may be done through acknowledging, respecting and facilitating productive interactions between dissimilar, but ultimately complementary occupational cultures. Clear agreement and enthusiasm for high-level goals can co-exist with fundamental assumptions and values that are in conflict.

In contrast to Levine’s (2006) assertion that conflict is detrimental to an organisation’s culture, Roberto (2005) champions the benefits of conflict in improving the quality of decisions, provided that it is paired with a consensus to execute decisions once they are made. In one CRC evidence existed for cross-
pollination of researcher culture, with its willingness to question and debate, with a commercial focus on planning and execution essential for the survival of the participating small and medium enterprises (SMEs). This did not occur serendipitously, but only by the conscious design and action of the CEO, working through the CRC’s Communications Manager. The CEO commented on the issue of using “creative dissent” in meetings of commercial and research members, and the fact that some of the industry partners had adopted rational argumentation as a technique for use inside their own organisations:

“I found it productive then [in a public sector organisation] and still do, when used sparingly. So it has wider application than just in the academic domain. Yes, I think some SMEs do use it, especially in their innovation activities, because this is where the employees are given a little more latitude to question and explore.” (Manager, IT Current)

However, it is unlikely that there will be wide-spread adoption of research forms of argumentation by industrial participants in hybrid research organisations, or that research participants will willingly accept arguments based on consensus or formal organisational authority. The debating norms of each occupational culture govern that community, are acquired through training or socialisation, and their display indicates that an individual chooses to remain a member of that group (McKerrow, 1980). Hence, the differing argumentation styles of research and commercial groups will be resistant to change. Nevertheless, if members of hybrid industry-research organisations understand and are aware of the norms and debating rituals of business and research occupational subcultures it may be possible to reduce misunderstandings and support successful commercialisation. To obtain the benefits promised from the formation of hybrid industry-research groups, it is important that each occupational subculture be free to employ its own subculturally appropriate rhetorical forms in single audience meetings. However, a consciousness of differences in styles of debate, in addition to modified use of research and business argumentation when occupational subcultures meet, are likely to be advantageous.
7.9 Summary of Findings Related to Occupation Specific Argumentation

This chapter presented and evaluated evidence for the use of occupation-specific argumentation contributing to tensions between research and commercial communities working in the context of commercialisation in Australian CRCs. Examining differing patterns of argumentation that stem from the ideational underpinnings of the occupational cultures led to a new contribution to knowledge: the impact of occupation specific styles of argumentation on commercialisation efforts in hybrid industry-research organisations.

The following chapter completes the research by answering the fourth question: How can occupational boundaries be managed to improve organisational processes and outcomes in Australian CRCs?
Chapter 8

Management of Occupational Subcultural Boundaries in Australian CRCs

Chapter 6, the first of the three results chapters, reported how the informants self-identified with two broad occupational subcultures within CRCs: research and commercial. It also revealed the role of post-graduate qualifications as a visible signal of subcultural membership, and the existence of occupation-specific patterns of activity aligned with attributions of priority to exploration or exploitation work tasks. In addition, reference to the literature concerning creativity and success in research activities explained commercial participants’ attribution of childish behaviour to research members of CRCs. Chapter 7 presented the main contribution to knowledge made by this thesis: identification of the potential for occupation-specific argumentation repertoires to act as a substantial barrier to commercialisation in hybrid industry research centres. This chapter answers the final research question: how can occupational boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?

From Chapters 2 and 3 it was found that previous researchers suggest members of research and commercial groups working together in hybrid industry-research centres will almost inevitably experience tension between their occupation specific norms and beliefs (Gibbons et al., 1994; Hackett, 2005; T. Kuhn, 2002; Sitkin & Stickel, 1996; Steiner, 2000; Trice, 1993). The nexus literature also suggests that the two groups will maintain their occupational subcultures despite contact with other subcultures (Meyerson & Martin, 1987; Trice, 1993). The informants’ inter-occupational struggles with the seemingly eternal challenge of balancing desires to increase product function at the expense of rapid market entry reflect the polarisation between exploration and exploitation approaches. Adherence to the deeply held
values and norms of research and commercial subcultures do not appear to have
appreciably changed during the passage of time (Merton, 1957) or through contact
(Garrett-Jones et al., 2005; Kassicieh & Radosevich, 1993; Steiner, 2000).

One imperative for hybrid organisations appears to be ensuring that constructive and
not destructive conflict results from the expression of occupational cultural
difference. Commercialisation is, by definition, a multidisciplinary activity,
involving substantial design, development, and testing activities after the initial
discovery. It also involves specialised knowledge of financial markets, distribution,
and marketing. Different skills and mindsets are required to prove the potential
feasibility of a product or service and bring it to market launch. The interviewees’
identification of the existence of separate subcultures with different priorities, forms
of debate, beliefs and assumptions, does not automatically jeopardise
commercialisation outcomes. Several informants commented on the potential for
synergy, and two interviewees (a manager and a researcher) volunteered the
challenge of working with the Intellectual Property departments of universities to be
larger than that posed by occupational subcultures:

“I think the biggest impediment to commercialisation is the
institutional impediment. Somehow institutions believe that intellectual
property is very highly valued and they want their return, and it’s a
very dangerous place to go because the expectations are unreal.”(Manager, CRC in formation)

Nonetheless, there was consensus amongst all interviewees that the ability to manage
inter-occupational conflict was a key skill for CRC managers. Sections 2 and 4 of
this chapter present a portfolio of potentially complementary techniques to manage
inter-occupational collaborations emerging from Progressive Comparative analysis
of the interviews.

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8.1 Desires to Change Australian Research Culture and CRCs.

The question of whether cultures can be intentionally changed polarises scholars. Scholars who do subscribe to the view that cultural change can be managed agree that achieving such organisational cultural change can be enormously difficult. As Schein (1996) advises ‘… norms held tacitly across large social units were much more likely to change leaders than be changed by them’ (p. 231). There is agreement that national, organisational or occupational cultural change is difficult to achieve and slow to effect (Kilmann et al., 1985; Schein, 1995).

As outlined in the introduction, and detailed in Chapters 2 and 4, the rise of national systems of innovation policies have encouraged individuals to work in ways that would have been considered improper, or even illegal, less than twenty years ago (Berger, 1993). Contemporaneously with Berger’s work, the first report of the Australian CRC Program Evaluation Steering Committee (CRC Program Evaluation Steering Committee, 1995), was published. The title suggested a new meaning for the acronym CRC; it was entitled ‘Changing Research Culture, Australia’ and asserted that:

… there is already clear evidence of a significant and beneficial change in research culture – especially insofar as it concerns universities and their cooperation with government research agencies and industry. The change in culture extends to industry and other research users who are showing a general enthusiasm for the program and a willingness to become actively involved with longer term and more basic research (CRC Program Evaluation Steering Committee, 1995, p. 1).

This was not an isolated, introductory comment. According to the report, the main achievement of the CRC program in its first five years was in changing research culture. Assertions that research culture needed changing appeared throughout the document. For example:

The program is having a beneficial impact on research culture in Australia an important aspect of which is a shift towards universities and CSIRO approaching industry to become involved in research focused on longer term outcomes. … The major success of the CRC Program is in producing a culture change in Australian research and education activity in support of research and development and especially in interaction with industry and other research users (CRC Program Evaluation Steering Committee, 1995, p. 6).
Despite declaring the CRC program had changed research culture in Australia, one indication that issues related to occupational subcultures in commercialisation had not been fully overcome in 1995 appeared in the report:

The challenges of marrying the cultures of industry and institutional research should not be underestimated. Each group holds its particular ethos in high esteem and in some instances a group can be quite resistant to even small compromises (CRC Program Evaluation Steering Committee, 1995, p.28).

Similarly, the 2003 Evaluation of the CRC Program (Department of Education Science and Training & Howard Partners, 2003) reported from consultations with stakeholders that one of the major contributions of the CRC program was its effect as, “A powerful change agent in research culture – away from the ‘ivory tower’ culture of universities” (Department of Education Science and Training & Howard Partners, 2003, p. 20). The government’s intent that the CRC program should function as a cultural change agent for the conduct of R&D in Australia is obvious.

However, it is possible to question the wisdom of attempts to make research institutions function more like businesses. Research, including the results of this thesis, points to the value of “multicultural adaptation rather than assimilation” in research collaborations across research and industry boundaries (Turpin, 1999, p. 244) and the desirability of occupational cultural difference between industry and research groups (Yee, 1996). If commercial and research subcultures merge, and become less distinct, it is possible that the complementary skills, abilities and assumptions which provide the rationale for industry-research collaboration will be lost.

Furthermore, if an integrationist organisational cultural perspective of hybrid industry-research organisations is unattainable, or even counter-productive, the practical question remains: how can occupational boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?

Despite clear evidence of inter-occupational tension and frequent reports of dissatisfaction, obvious attempts to build a single, integrated organisational culture in the four CRCs explored were not evident. While members of both research and commercial groups expressed frustration at what they perceived to be inappropriate
behaviour and beliefs from the other group, they recognised that attempting to build a single set of norms, beliefs and values would harm the organisation and its commercialisation efforts. They saw potential benefits in the existence of different occupational cultures, a finding that to some extent runs contrary to espoused aims of changing research culture (see Chapter 1). Participants’ acceptance and adoption of a differentiation perspective of organisational culture was apparent in the research, as was acknowledgment of the need to manage the gap between the individualism and open publication of the research world and the team based, money making ethos of corporate partners.

8.2 Secondment, Boundary Crossers, and Boundary Objects

Steiner (2000) asserts that more than conventional science skills are required to be an innovator, or to produce science of interest to industry. In fact, she proposes that the norms and beliefs inculcated in a good scientific education may inhibit the ability to work with industry. Furthermore, conflict exists between cultural values that view knowledge-making as the desired goal, and commercial value systems devoted to money-making (Biggart, 1998; Steiner, 2000). Thus, a boundary-crossing researcher-manager, able to shift their cultural frames and decide when to be a “good” researcher and work by the book, and when to be “incompetent” and digress from accepted scientific practice can be invaluable to innovation efforts (Steiner, 2000). Attempts to use secondment to develop boundary-crossers, and evidence of the existence of boundary crossers and boundary objects in the CRCs are assessed in the following sections of this chapter.

8.2.1 Secondment

Diversity and multicultural bodies of literature recommend secondment as a way of providing the tacit knowledge needed to work within an unfamiliar culture by immersing individuals into that culture (Fernandez, Mutabazi, & Pierre, 2006; Pires, Stanton, & Ostenfeld, 2006). Informants explained that the first CRCs were unequivocally encouraged to second individuals into their partner organisations in
the CRC organisation, but this did not commonly occur. It is likely that the thick subcultural boundaries inhibited the use of secondment as a tactic to provide cultural understanding, especially from business to research positions.

For instance, the Biomedical Graduate CRC had used physical secondment to immerse an individual into the other occupational culture, possibly with a view to developing boundary-crossing individuals:

“…by putting a scientist within a company, ... that created a day-to-day experience of the drivers of company and commercial concerns so that the work was done in the context of the need for specifications, for reproducibility, for product integrity.” (Researcher, Biomedical Graduate)

This secondment approach was under active consideration in the IT Current CRC. However, a researcher from the Biomedical Current organisation raised practical objections to the use of immersion via secondment:

“The original concept behind the CRC scheme as put forward by the government was that people would come together onto a single campus and the research would all be there, [in that] place. But once you start off with parties that are not already in the same location that was never going to happen because what you would require is for the parties to effectively give up their best people to somewhere else. And it just wasn’t going to happen and it hasn’t happened in our place.” (Researcher, Biomedical Current)

Indeed, the low incidence of secondment shown in the table in Appendix 16 suggests that it has proved unpopular in the four Australian CRCs explored. Of the twenty individuals interviewed, only four had experienced physical secondment. Of these four, three came from the Biomedical Graduate CRC, one from the IT Graduate CRC. No informants from the two currently funded CRCs had experienced secondment. Given that secondment appears to becoming increasingly unpopular with CRC organisations, it is unlikely to provide a solution to inter-occupational tensions in the future.

The intent of secondment is to develop some of the characteristics of boundary-crossers, individuals equally at home in more than one culture. In addition to the desirability of individuals able to cross the boundaries between researchers and
practitioners, Kuhn (2002) adds the use of boundary objects, in the forms of artefacts, activity routines or reified concepts as a potential means of managing boundary conflict in a constructive and positive manner. The reported influence of boundary crossers and boundary objects in the four CRCs are next considered.

8.3 Evidence of Boundary Crossers and Boundary Objects

The boundary crosser and boundary object strategies advocated by Kuhn (2002) to lessen the impact of occupational subcultures were described by respondents from all four CRCs. Four interviewees displayed characteristics of boundary-crossers: key individuals who are skilled and often certified (holding educational and professional qualifications) in two distinct bodies of knowledge, and who translate the behaviour, knowledge-systems and social values of one group for the other. In the Biomedical Current CRC the use of boundary objects as a strategy to link separate occupational groups was also evident. A formal procedure, the Design Control Process (DCP), tracks the development of initial research ideas, manages what is included and what is left out of prototypes and then moves control from research to design engineering personnel, on to production engineering, and finally to business unit management. The DCP’s organisational cultural function was detailed in Results Chapter 6, and is incorporated into an extended process theory model of innovation in Chapter 9, Implications and Recommendations.

In addition to the boundary crossers and boundary object techniques, the informants described a range of other techniques they had found helpful in managing inter-occupational interactions.

Management techniques that accommodated the motivations and norms of both occupational subcultures were described. These include feedback loops to provide credit, appreciation and recognition to the research team at the conclusion of commercialisation projects; promotion of the CRC name and identity as a way of defusing inter-university rivalries about which institution is seen as most eminent; offering recognition and prestige as inducements to researchers to work in
commercial collaborations; and using different versions of the same business plan for different audiences.

In addition to attempting to accommodate the differences between commercial and research occupational subcultures, two tactics were employed to avoid tension through permitting both groups to operate independently for at least part of the time. Separate industry and research committees operated independently and gave direct advice to the CRC board in the IT Current CRC, and a researcher from the IT Graduate CRC explained that colleagues had avoided inter-occupational conflict by developing fledgling organisations completely within the boundaries of research groups, and then making a clean break when selling them off to commercial groups. The researcher volunteered that the companies may grow at a slower rate using this approach, but saw compensatory benefits:

“They have sold the companies and started new companies and now they are self-funded they don’t need venture capitalists. And maybe the size of the company is smaller and the growth is slower, not so steep, but they can manage that and derive more pleasure from working in those companies.” (Researcher, IT Graduate)

A manager from the Biomedical Graduate CRC advocated the use a mix of monetary incentives, coercion, persuasion and contact:

“A scientist says ‘You’re in that [commercial] group and therefore I don’t have to think much harder about it’ and you can bludgeon them down with money, you can persuade them and I think in different cases you need to use both of those approaches. In terms of building structures to dissolve that barrier I think the only thing you can do is try to make as many interactions as possible which I guess is what CRCs were about. I don’t think there’s any obvious solution to it. I used to be quite positive about CRCs, less so now just because the history has been not great and because they tend to be run by scientists and they haven’t really managed to avoid this problem of being really just supplements to grants.” (Manager, Biomedical Graduate CRC)

The three individuals interviewed from the Biomedical Current CRC each identified different processes used within their CRC to manage inter-occupational tension. Consistent with commercial desires for cohesion and conformity discussed in Chapter 7, the CEO was identified as using political processes to pre-empt conflict occurring:
“... the CEO will canvass and potentially polarise opinion prior to meetings in order to secure smooth passage through the political minefield of the different stakeholders’ opinions. ...... it generally doesn’t become contentious at the board level as a result of the ferreting around behind the scenes and trying to talk the issues through to a common outcome.” (Manager, Biomedical Current)

However, the manager also expressed some dissatisfaction with this approach:

“You almost get the view that says the corporate entity, or core parties in this case, will ultimately get what they want and then the CEO’s job is to manage the scientific component underneath it to suit.” (Manager, Biomedical Current)

A researcher from the Biomedical Current CRC advocated selecting only low risk, highly certain projects for research and industry collaborations. However, in his view, the cost of this compromise was a reduction in the chance of performing breakthrough research.

Finally, the third informant from the Biomedical Current CRC described the Design Control Process (DCP) as functioning as a mechanism to signal passage from one culture, showing when exploration merges with exploitation, and when exploitation activities became dominant. It is interesting to note that the DCP supports structured contact between the two groups. Communication and time spent in formal meetings, negotiating and documenting agreements at the beginning of the commercialisation cycle may act as a structural intervention to decrease the likelihood of inter-occupational miscommunication based upon the application of undocumented, but deeply held, occupational norms and assumptions. The impact of exposing the two groups to each other and getting small, documented agreements early in the cycle is consistent with the development of shared norms and reports of improvements in resolving intra-group differences (Bettenhausen & Murnighan, 1985). Additionally, the DCP was reported to function as a ritual encompassing several rites, which allows controlled contact between the two occupational cultures and assists jurisdiction to be transferred from inventors to prototype developers and finally to production, in a planned and consensual manner. Section 6 of Chapter 9, Directions for Future Research, considers these possibilities in the light of existing research findings concerning process management theories of innovation.
The existence of boundary-crossers is identified both as an accelerant of commercialisation (Cyert & Goodman, 1997; Steiner, 2000) and productive relations between practitioners and academics (T. Kuhn, 2002). The benefits observed when organisations have the right combination of skills in a person motivated to use them to act as a “translator” between the two communities, rather than to use their expertise to build a personal power base were clearly expressed by the researcher in the Biomedical Current CRC (see Chapter 6, page 116). However, boundary-spanning strategies to overcome occupational subcultural difference rely upon the ability to identify, recruit and retain these scarce individuals. The existence of boundary-crossers or spanners is undoubtedly an advantage for hybrid organisations, but is not sufficiently robust to be relied upon as a primary mechanism for overcoming the potential for cross-occupational cultural misunderstandings. Researching methods to develop boundary objects as readily accessible and low cost methods of linking research and commercial occupational subcultures, has high priority as an avenue for future research, as is discussed in section 9.6.

8.4 Diversity and Intra-Group Conflict Theories

An extensive literature has developed around race, gender, age and other demographic forms of workplace diversity (R. J. Ely & Thomas, 2001). This workforce diversity literature is potentially applicable to “invisible” forms of diversity, such as the occupational thought-worlds of researchers and commercial personnel described in this research. In support of this possibility, the first two characteristics of diversity Gilbert and Ivancevich (1999, p. 31) list as triggering workplace conflict are differences in thinking styles and speech patterns. Chapters 6 and 7 of this research demonstrate the existence and impact of different patterns of debate and divergent priorities for exploration and exploitation for research and commercial occupational subcultures identified by CRC informants. However, integration of diversity will not be an effective model for collaborative organisations such as CRCs, as they have strong boundaries between members of occupational cultures, and valid reasons exist for maintaining distinctive and separate competencies and occupational communities.
In their integrative model of the relationships between diversity, conflict and performance, Pelled, Eisenhardt and Xin (1999) studied the impact of “functional” or occupational diversity, in addition to “immutable” forms of diversity based on demographic characteristics such as age, gender, and ethnicity. In examining how workgroup diversity can indirectly affect task performance through intra-group task conflict, and intra-group emotional conflict, they determined functional diversity can increase performance, and also increase task conflict. However, the cross-functional teams they studied were composed of members drawn from the electronics division of the same business organisation. Furthermore, they explicitly state that the functional backgrounds were permeable, positing that employees would find it easier to identify with those of a different functional background than with those of a different race, gender age or tenure in the company:

Employees often can transfer from one functional area to another if they simply want exposure to another area or if the conditions in another area are better… (Pelled et al., 1999, p. 5)

Such easy and uncomplicated movement between research and commercial functions does not occur in CRCs given the strength of occupational subcultural boundaries. It is possible that the strength of the boundaries between research and commercial occupational communities give rise to not only task related conflict, but also emotional conflict which Pelled et al (1999, p. 4) describe as ‘… clashes characterised by anger, resentment and other negative feelings’. As the results of thematic analysis show (Nvivo codes generated from the interviews are in Appendix 10), negative emotions, suggesting the presence of emotional as well as task based conflict featured in the informants’ descriptions of inter-occupational relations. It is important to note that while task conflict is associated with favourable effects on cognitive task performance, emotional conflict often has disruptive effects. Furthermore, when a newly formed group performs non-routine tasks, higher levels of intra-group task and emotional conflict appear (Pelled et al., 1999).

The above suggests that CRCs, and similar hybrid organisations relying on cross-functional teams that span organisations as well as occupations, to perform non-routine tasks within set time limits, may be particularly prone to both task based conflict and emotional conflict.
Gilbert and Ivancevich, (1999, p.30) define “proactive corporate diplomacy” as a body of strategies to minimise conflict in a diverse workplace in order to manage race and gender based tensions in the context of US corporations. Several components of their approach may be adapted to address workgroup tensions based on occupational subcultural differences. Both of these possibilities lead to opportunities for further research, some of which are included in Chapter 9.

As described in this chapter, the members of each CRC used more than one approach to manage occupational boundaries. Personal solutions, derived from experience rather than any formal CRC training programs, ameliorated the impact of occupational boundaries and led to improved organisational processes and outcomes. Having answered the final research question, the next and final chapter summarises the research, considers the implications of the findings in relation to management theory and existing literature, and concludes the thesis.
Chapter 9

Implications and Recommendations

9.1 Introduction

In the introductory chapter I identified the thesis problem and proposition: that occupational subcultures may be imported into CRCs and influence commercialisation outcomes. The three literature review chapters provided the theoretical foundation for the research; innovation and organisational culture theories were expounded in Chapter 2, in Chapter 3 occupational cultures were considered and in Chapter 4 hybrid organisations in general, and Australian CRCs in particular were examined. Chapter 5 justified the choice of qualitative methodology and the research design and described the recruitment process.

Chapter 6, the first of three results chapters, explained how the informants self-identified with two broad occupational subcultures within CRCs: research and commercial. In addition, this chapter revealed the role of post-graduate qualifications as a visible signal of subcultural membership, and the existence of occupation-specific patterns of exploration and exploitation activities with corresponding attributions of priority to exploration or exploitation work tasks. Reference to the literature concerning creativity and success in research activities explained commercial participants’ attribution of childish behaviour to research members of CRCs. Chapter 7 contains the main contribution to knowledge made by this thesis. The literature on innovation and argumentation had not previously considered the potential for occupation-specific argumentation repertoires to act as a substantial barrier to commercialisation in hybrid industry research centres. Then, Chapter 8 addressed the question of managing occupational subcultural boundaries in
Australian CRCs drawing upon the literatures concerning boundary crossers, boundary objects and workplace diversity management.

This chapter concludes the thesis. First it summarises the findings regarding the research questions, then presents conclusions about the research problem and identifies contributions to theory. It also presents implications for policy and practice, and for further research. This chapter also addresses limitations which became apparent during the research.

9.2 Summary of Findings in Relation to Research Questions

The informants spoke at length about each of the four research questions, and several stated the thesis topic held a great deal of interest to them. A summary of the findings in relation to each of the research questions follows.

9.2.1 Findings: Existence of Occupational Subcultures.

The interviewees demonstrated clear familiarity with the research topic and identified the existence of subcultures as vital for innovation and also a frequent cause of delays and miscommunication in CRCs. They described visible signs of occupational groupings working in commercialisation, the values and beliefs of particular cohorts and perceived boundaries between commercial and research occupational subcultures. Such ability to rapidly grasp and articulate the notion of occupational subculture may be attributable to acumen and education. However, the emotionally charged responses from members of both research and commercial groups, often expressing frustration, suggest that the impact of different styles of occupational argumentation in commercialisation extends beyond mere intellectual awareness.

Agreement that occupational subcultures existed and at times impacted on commercialisation outcomes was unanimous. The only difference of opinion related
to the number of occupational subcultures. Several informants described “two tribes” (research and commercial) or “three tribes” (researchers/engineers/managers, or commercial/government/research) co-existing in the same world. In addition, some interviewees viewed the boundaries between the groups as impermeable, supporting interpretations of separate and distinct worlds. This finding was unaffected by the age of the organisation or its sector affiliation.

9.2.2 Findings: Boundary Characteristics of Occupational Subcultures.

While there are strong boundaries between research and commercial communities, several interviewees had moved from research to management positions. Given that some specialised research groups were viewed as closed communities these boundary-crossers provide a potential human link between the research and commercial occupational subcultures.

On the other hand, no interviewees had moved from a commercial to a research position. The informants commented that it was not sensible or desirable to do so. The characteristics of boundaries between research and commercial subcultures, inferred from the testimony of the informants, can be summarised as highly meaningful, highly visible, generally impermeable and durable. Although there are signs of a slight reduction in the strength of the boundary between commercial and research groups, likely to be due to government intervention, the strength of individuals’ responses in this research suggests that the two groups will continue to be separate and distinct.

9.2.3 Findings: Impact on Commercialisation Processes and Outcomes

The interviewees had clear intellectual understandings of the potential benefits of collaboration and the necessity of using complementary research and commercial skill sets in commercialisation activities. However such benefits appeared distant when dealing with the day to day frustrations that seem to stem from the “other”
group’s apparent inability to understand or follow the norms that seemed self-evident to each community.

The perceived impact of occupational subcultures is negative. The level of difficulty encountered varied from consciousness of tension between motivations and approaches to tasks, to complete breakdown of communication. It is noteworthy that in one organisation similar issues were reported to occur within the boundaries of the research community.

Some examples of the barriers to successful commercialisation reported to result from the existence of disparate subcultures include:

- Insistence upon, or intolerance of, dissent in shared meetings.

- Engaging in “satisficing” in decision making, i.e. settling for the first option that can work for the situation, rather than an optimal solution. This occurs particularly when trying to balance individual stakeholder needs (research, industry, government) with organisational goals.

- Protracted negotiations over ownership of IP and the financial value allocated to “know-how”, and continuing disputes regarding fair recognition for contributions made.

- Different expectations about the frequency and depth of communication required with collaborating partners.

- Perceptions that one group is benefiting at the expense of the other.

- Opposing priorities stemming from different motivations, such as conflict over the desirability of adding features versus reducing manufacturing costs and the wisdom of delivering products on-time with reduced function versus late with enhanced function.
9.2.4 Findings: Managing occupational boundaries in CRCs

As described by the organisations represented in the research, two main strategies lessen the impact of occupational subcultures. One involves the use of boundary-crossers. These key individuals, skilled and often certified (holding educational and professional qualifications) in two distinct bodies of knowledge, translate the behaviour, knowledge-systems and social values of one group for the other. The second strategy is process based, using formal procedures to track the development of ideas, manage what is included and what is left out of prototypes and then move control from research to design engineering personnel, on to production engineering and finally to business management.

CRCs are not organisations that occur naturally. The parties did not decide to combine their knowledge, skills or resources in the absence of external inducements. Instead, CRCs are coaxed into existence through monetary incentives that encourage industry to work with, and invest in the findings produced by research organisations. The impetus for universities and government funded research organisations to participate has been one of coercion for research institutions and inducement for business. Sources of funding are increasingly linked to demonstration of clear “routes to market” for a discovery or innovation. The likelihood of gaining funding is higher for researchers working with members of industry with a clear intent to create a product or service for sale, or intellectual property (IP) to license.

As discussed in Chapter 6 page 95, Government innovation policy has acted to “graft” dissimilar organisations and occupational cultures together. Whether or not the organisation thrives and becomes productive will depend to some extent on the management of occupational cultural differences between research and industrial members. The “two tribes” have a history of working separately. They occupy separate thought worlds, use different norms and have disparate assumptions about goals and methods of working. They do not really need each other for survival, provided government funding to research institutions continues, even if at a reduced rate. Predictions of synergy (a combined effect greater than the sum of the individual forces) resulting from the CRC Program are over-ambitious. The strength of
researcher culture, and perceptions of the necessity of its norms for effective and efficient knowledge creation, suggest management efforts to make “them” more like “us” will fail. Similarly, expecting business people to put aside the norms and assumptions that serve them well in commercial activity is likely to be a futile endeavour. The improved outcomes associated with inter-disciplinary or cross-functional teams may not be replicated in inter-occupational and inter-organisational collaborations, where there is a greater distance between cultural assumptions, values and norms.

A constructive form of symbiosis is likely to be the best organisational outcome for temporary alliances of members of research and commercial occupational subcultures. Expectations of synergy, while politically and economically attractive, are unlikely to be met, with regrettable assessments of failure applied to both commercial and research groups. Setting an organisational goal of a mutual form of symbiosis, where both branches of the grafted plant are fruitful, all participants benefit and government innovation objectives are satisfied, may be more realistic.

The patterns of interaction and perceptions reported by participants describe experiences closer to symbiosis rather than synergy. In biological terms symbiotic relationships run the gamut from competition and parasitism through commensalism (in which one member of the association benefits while the other is not affected) to mutualism, in which the association is beneficial to both parties. The managerial question appears to be how to best bring about a constructive form of symbiosis and to avoid damage to individuals and member organisations.

The distance between the assumptions, beliefs, values and norms of the subcultures associated with research and commercial communities necessitates acknowledgement and efforts to accommodate their differences. Both are efficient and effective in their own contexts, but thought, effort and action are needed to improve inter-occupational working patterns, communication and outcomes.
9.3 Contributions to theory

This research makes at least two contributions to theory. The first is a testable theoretical proposition regarding argumentation as barrier to commercialisation. The second is the explicit identification of the need to incorporate linking mechanisms between subcultures, such as transition ceremonies, in process management theories of innovation. These mechanisms are needed to ameliorate the inherently oppositional forces that exist between research and commercial occupational subcultures working in hybrid research centres, and in all likelihood, many other organisational settings for innovation as well. Previous research warning against the use of process management techniques in exploratory R&D activities, and describing escalating cycles of distrust between members of research and managerial occupations when TQM programs are applied to research activities (Sitkin & Stickel, 1996) may have overlooked the potential for process techniques to link occupational subcultures in the commercialisation phase of innovation. I propose that process theories of innovation, when applied with awareness of the characteristics of occupational subcultures, may function as organisational cultural boundary objects and ease the transition from exploratory to exploitative phases of innovation. The following sections consider each of these contributions in turn.

9.3.1 Implications for Argumentation in Innovation Theory

Using an inductive process of theory generation (Eisenhardt, 1989) the argumentation theme arising from the interview data was developed into the following theoretical proposition: the achievement of commercial results in hybrid industry-research organisations can be jeopardised by misunderstandings based upon the styles of debate used by business and research/academic communities. Differences in expectations of time limits and specific outcomes, combined with divergent attitudes towards public dissent, reflect occupational tendencies towards either exploration and knowledge production, or exploitation of market opportunities for monetary gain. Members of each community regard the debating norms of the other group as unusual and an obstruction to equal participation, contributing to frustration and barriers to communication and commercialisation. This theoretical
proposition offers many avenues for further research, using qualitative, quantitative or mixed method designs. Future research could consider research and commercial argumentation across national, disciplinary and organisational boundaries and organisational types.

9.3.2 Occupational Culture and Process Theories of Innovation

This research points to a need to extend existing process theory models of innovation. Current process theories of innovation make only passing reference to cultural factors. In addition, integrationist assumptions are clear in prescriptions for organisational innovativeness. For example, executive support for innovation is presented as the action that creates the consensus to pursue particular innovations in an organisation (Hoffman & Hegarty, 1993; Papadakis & Bourantas, 1998). In organisations where the differentiation perspective is clearly dominant, such as hybrid industry-research organisations, support and champion roles will be required in each stakeholder community, and in CRCs this may well mean thought leaders in a number of research and business communities.

As reviewed in Chapter 2, process theories of innovation have greatest applicability to the commercialisation stage of innovation. Organisational Innovativeness theories are ill-suited to the CRC context given their traditional focus on innovativeness within a single organisation, coupled with an integrationist perspective of that organisation’s culture. However, a clear danger associated with implementing process theory models of innovation when working with strong occupational subcultures is the possibility that each stage or toll gate will create opportunities for wilful miscommunication and a battleground for project control. Structured handover points may increase the visibility and significance of already strong cultural boundaries.

In contrast, the results of this research point to an opportunity to extend existing process theories of innovation to acknowledge the roles of distinctive exploratory and exploitative groupings of occupations, and incorporate the impact of the differentiation perspective of organisational culture. In contexts where differentiation
is likely to be strong and the integration perspective predicted to be weak, such as hybrid organisations, cultural factors will have a significant influence upon outcomes.

However, stage models of innovation processes are out of favour with some innovation management theorists, viewed as too slow to be able to accommodate the need for change in fast-paced industries (Rogers, 1996) and failing to acknowledge the role of tacit knowledge and interpersonal relationships (Miller & Morris, 1999). “Open” and Fifth generation process theories of innovation are recommended to succeed them as the preferred models (Berkhout et al., 2006; Chesbrough et al., 2006; Rogers, 1996). These models favour expansion of the number of stakeholders involved, and the frequency with which they are involved (Rogers, 1996), increasing use of research findings sourced outside the firm (Chesbrough et al., 2006) and cyclical rather than linear models of innovation (Berkhout et al., 2006). While encouraging the importation of research from other organisations these theories do not specify how to manage the boundaries with these organisations. However, as illustrated by my research, an issue likely to be encountered by hybrid industry research organisations using open innovation models is how to manage the border crossing between exploration/knowledge absorption activities and exploitation or “wringing out” phases of innovation (Fiol, 1996).

Study participants from the Current Biomedical CRC organisation reported the successful use of a variant of process management theory to manage this boundary. While the Design Control Process was initially implemented to meet the regulatory reporting requirements of the medical device industry, it was clearly fulfilling a secondary, cultural function: that of providing a system of rites and rituals to clarify the “grey area” when the innovation passed from the control of one community to another. For example, a purpose built, small clean room was used only for the functional and symbolic transfer of ownership from design engineering to production engineering. When the ceremony was successfully completed, production engineers took control of the new device and set up manufacturing in the main clean room in a different building on the same campus. This activity signified a discrete toll gate, as well as serving a ceremonial role too.
As described previously, this evidence of a stage-gate process functioning to bridge exploratory and exploitative groupings contradicts theoretical works which advocate strict quarantine of R&D from process management techniques (Benner & Tushman, 2003; Sitkin & Stickel, 1996). However, it is important to emphasise that the innovation context in which CRCs work is that of commercialisation. When organisations commit to work together in a CRC it is for the purpose of bringing a product or service to market, with an expectation of economic or public good returns. Hence the setting is different from that occupied by researchers conducting fundamental research, and different norms, expectations and psychological contracts are likely to hold sway for the duration of the CRC.

Figure 9.1 below shows a schematic representation of a generic stage gate process extended to acknowledge and accommodate occupational cultural proclivities towards exploration or exploitation.

**Figure 9.1:** Extended Process Theory Model of Innovation Incorporating Transition Ceremony and Recognition Feedback Loop.

The orchestration of explicit ceremonies for transition from exploration to exploitation phases is worthy of management attention and support. The addition of a feedback loop to the standard, linear process model, offering opportunity for prestige and recognition within specialised research communities from commercialisation projects, is most important. The addition of the feedback loop provides a mechanism
to deliver the prestige and recognition that underpins the motivation of many researchers. Any process to improve the visibility of successful researchers within their community, and to link them to the segment of society benefiting from their work, such as including their name in the product or service, is likely to improve their engagement and reduce feelings of intellectual servitude.

Each group needs to pursue its occupation-specific paradigms for problem solving and adhere to its occupation-specific norms in order to efficiently and effectively produce its prime output, whether knowledge or money. Each culture assists the group pursue its goals in an effective, purposeful way. However “buffers”, in the form of boundary-crossing individuals and/or mediating processes, are required when the two meet and work together.

This thesis has achieved several aims. First, the inductive theory of the action of occupation-specific argumentation repertoires as a barrier to commercialisation represents new knowledge. Second, the identification of assumptions, motivations and styles of debate characteristic of research and commercial occupational groups helps to explain long-standing barriers to productive research and business interactions. Third, the proposal to extend Process Theories of Innovation to acknowledge and increase occupational subcultural engagement with stakeholders from research, and commercial stakeholder communities provides avenues for new research. In particular, managing the involvement of multiple occupational subcultures through the use of cultural forms such as rites, rituals and ceremonies may increase the speed and ease of commercialisation.

Table 9.1 below displays the links between the relevant literatures, the research questions, the methodological choices and contributions to knowledge and theory made by this thesis.
<table>
<thead>
<tr>
<th>Research Question.</th>
<th>Relevant Literature Providing the Theoretical Foundation for the Thesis.</th>
<th>Methodology.</th>
<th>What Contribution Does This Make to Knowledge or Theory?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do members of CRCs engaged in commercialisation recognise subcultures in their organisations and if so, how do they describe and identify the subcultures?</td>
<td>Organisational culture, especially 3 perspectives view of Occupational Subcultures. Organisational cultural forms: artefacts, symbols, norms, beliefs/values and assumptions, reported from previous research into scientists and managers working in innovation. Foundation literature on argumentation.</td>
<td>Use of temporary, hybrid industry research organisations engaged in new product development to provide a suitable environment to study the importation and impact of occupational subcultures. Observation, collection of experiences and insights of the individuals directly involved in commercialisation through semi-structured interviews.</td>
<td>Support for Nexus and the dominance of Martin and Meyerson’s differentiation view of organisational culture in hybrid industry-research organisations. Identification of research and commercial occupational subcultures broadly aligned with exploration and exploitation innovation activities. Occupation specific argumentation styles identified and recognised as potential barriers to commercialisation.</td>
</tr>
<tr>
<td>2. What can be determined about boundaries between subcultures in terms of shape, thickness and permeability in the context of commercialisation practices and outcomes?</td>
<td>Organisational culture theory related to boundaries. Douglas’ grid and group theory; who to include or exclude as the two main questions answered by culture. Literature concerning boundary crossers in innovation.</td>
<td>Observation, collection of experiences and insights of the individuals directly involved in commercialisation through semi-structured interviews. Review of careers of individuals interviewed, have they moved between occupational groups? Would they consider moving?</td>
<td>The boundary characteristics between research and commercial occupational subcultures, inferred from the testimony of the informants, can be summarised as highly salient, highly visible, generally impermeable and durable.</td>
</tr>
<tr>
<td>Research Question.</td>
<td>Relevant Literature Providing the Theoretical Foundation for the Thesis.</td>
<td>Methodology.</td>
<td>What Contribution Does This Make to Knowledge or Theory?</td>
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<tr>
<td>3. <em>How do CRC members perceive that occupational subcultures impact upon their work?</em></td>
<td>Primarily driven from interview data – linked to other studies citing positive or negative impacts of occupational subcultures in commercialisation or other aspect of innovation (adoption, diffusion etc). Process Theory models of innovation are the relevant theoretical stream as the commercialisation stage of innovation has much in common with new product development. March’s exploration and exploitation in organisational learning and Fiol’s sponge analogy of absorptive capacity coupled with ability to “wring” innovation out of the sponge.</td>
<td>Observation, collection of experiences and insights of the individuals directly involved in commercialisation. Collecting metaphors for experience of commercialisation after discussion of impact of subcultures. Triangulation with government survey material regarding CRC performance and member assessments of working relationships.</td>
<td>Members are acutely aware of subcultures and their impact. The perceived impact of occupational subcultures on commercialisation is negative. The level of difficulty encountered varied and the interviewees had clear intellectual understandings of the potential benefits of collaboration and the necessity of using complementary research and commercial skill sets in commercialisation activities. However, such benefits appeared distant when dealing with the day-to-day frustrations that stem from the “other” group’s apparent inability to understand or follow the norms that seem self-evident to each community.</td>
</tr>
</tbody>
</table>
4. **How can occupational boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?**

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</table>
|   | Link literature on managing cultural diversity with Process theories of Innovation. Best result likely to result from the modification of process theories of innovation to incorporate and improve cross-cultural communication and transitions. | Synthesis of results and existing literature applied to improve process models of innovation. Secondment is not widely used by CRCs despite being part of CRC charters. Alternative methods to link the subcultures are required. Boundary crossers MAY be available and MAY be cooperative, but cannot be assumed to exist. Processes may substitute for, or supplement boundary crossers to perform boundary linking roles. Extension of linear Process Theory models of innovation to incorporate a feedback loop delivering prestige and recognition to researchers. The orchestration of ceremonies and rituals at key points may help transfer innovation outputs, make the move from exploration to exploitation explicit phases explicit and reduce “border disputes”.
|
9.4 Implications for Policy and Practice

Perusal of the standard agreement to create a CRC (Appendix 5) reveals a legalistic focus upon ownership of assets, funding payment schedules and reporting. While mechanistic contracts employing formalisation, standardisation and compliance measures have been proposed as a tactic to accelerate the development of, or restore trust, they can also exacerbate perceptions of difference (Sitkin & Stickel, 1996). This research has shown that the clear definition of responsibilities and obligations in the Agreement to form a CRC are insufficient to address the inherent tension between research and commercial groups working in commercialisation. A clear need exists for familiarisation and cross-cultural training for members of research and commercial occupational communities in CRCS.

Chapter 8 presented a variety of tactics to avoid emotional conflict and manage constructive task based conflict. The application of diversity and intra-group conflict theories within the CRC organisational context may provide opportunities to ameliorate inter-occupational tension. It also offers opportunities for further research (see section 9.6). Given the unique structure, organisational culture and occupational subcultures of each CRC, it may be necessary to tailor and deliver training that takes into consideration the composition of each CRC.

9.5 Limitations of the Research

As described in section 1.8, Delimitations of Scope and Key Assumptions, although the issues documented and analysed in this thesis may be identifiable by the larger cohort of researchers and managers working in hybrid industry-research organisations in other countries, this research is limited to the Australian CRC program, and the participating organisations when interviewed in 2005. In addition, my personal interpretive frames may have influenced the direction of the research and the analysis of the results.

Other limitations to the research exist. These limitations are associated with a lack of historical data about managerial occupational culture in hybrid industry-research
organisations to assist in comparing the reported behaviours to other studies. The ability to draw upon my experience as a manager, albeit not in a hybrid organisation, helped in understanding, and interpreting, the experience of commercial managers.

Notwithstanding the above, the participants’ positive feedback to the results working paper sent to them suggests that the work accurately reflects their experiences. Importantly, and given the efforts made to ensure the research methods were robust (see section 5.4), the insights provided by the interviewees have potential to extend existing theory to consider the impact of occupational subcultures on the functioning of hybrid research centres, and extend process theories of innovation.

### 9.6 Directions for further research

Complexities and contradictions abound in the organisational context of hybrid research centres, making them a fertile setting for future research. The findings of this research regarding the existence and influence of occupational subcultures in commercialisation raise new questions that represent potential topics for future work. Table 9.2 below, taken from the working paper distributed to participants (Appendix 6) provides an indication of potential topics for future research, which are expanded upon in this section.

#### Table 9.2 Belief Based Boundaries Between Commercial and Research Subcultures

<table>
<thead>
<tr>
<th>Subcultural Boundaries</th>
<th>Commercial Beliefs</th>
<th>Research Beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debate</td>
<td>Extensive public dissent is inefficient and divisive.</td>
<td>Extensive public dissent essential and constructive</td>
</tr>
</tbody>
</table>
Power/Status Perceptions

| Clearly in control of funding, less control over personnel than is usual. | Resentful, perceptions of reduced status and autonomy. |

9.6.1 **Power Relations within Hybrid Industry-Research Centres**

Examining the prevalence of satisficing in decision making in hybrid industry/academic/government research organisations may illuminate power relationships within Hybrid Industry-Research Centres. This research uncovered beliefs among researchers that industry partners possessed overt power in the relationship while the research members were supplicants, going “cap in hand” to beg for money. Consideration of the complex net of power relations between researchers and managers offers many promising avenues for future research. An improved understanding of the basis of these beliefs and power relationships would assist in organisational functioning, and may have applicability beyond hybrid industry-research organisations, to other organisational contexts such as joint ventures.

9.6.2 **Theories of Hybrid Organisations**

Trust, forbearance and other “soft” factors have been identified as key to international joint venture collaborations between for-profit organisations in same industry (Parkhe, 1993). Hybrid industry-research centres face additional challenges: developing trust when the private companies in the CRC are market competitors and the task of building trust between organisations that have different aims (knowledge vs. money making), different structures and well established, disparate norms for behaviour. Tracking levels of trust and commitment between CRC members over the 7 years of CRC funding may provide useful insights into the stages, accelerants and hindrances to the development of trust in hybrid organisations. Such research would extend the work performed on industry-research dyads in Australia (Plewa & Quester, 2005) to networked, hybrid organisations and increase understanding of the impact of the importation of occupational cultures over time.
9.6.3 Organisational and Occupational Cultural Research

Just as argumentation repertoires appeared as a barrier to commercialisation in the CRCs explored, there were signs that the temporal orientations of research and commercial occupations differ, and may also create obstacles. Extension of the interviews to other organisations would be of value, and further work to clarify the link between hierarchy and debate is justified. Moreover, consideration of cultural forms, such as project schedules and the addition of a quantitative measure of polychronic and monochronic behaviours in research and commercial occupational groups may help to map the occupational cultural assumptions of research and commercial occupational groups. In turn, this would provide material to use in cross-occupational cultural training for members of hybrid industry-research groups. Furthermore, exploratory interviews with prominent boundary-crossers may assist in developing a model of what leads individuals to cross occupational boundaries, and what keeps them working within the research community.

As remarked upon in Chapter 3, the scholarly portrayal of managerial culture is far from flattering. Personal observations and the results of this thesis challenge this representation of managerial culture. A future goal will be to develop a more balanced and nuanced view of management culture in the 21st century.

9.6.4 Innovation and Occupational Culture

Sitkin and Stickel (1996) assert that process management techniques stabilise organisational routines and tighten the linkages between them, and yet make cross boundary, cross community linkages more difficult. This contradicts the occupational cultural bridging function performed by the Design Control Process (DCP) used in the Biomedical Current CRC. The DCP appears to coordinate the activities and manage the expectations of multiple stakeholders from a variety of disciplines and organisations. An in depth analysis of the linking role performed by the DCP in this particular organisation could help to resolve the apparent conflict of evidence. It may be the case that while process management tools may not be applicable to basic or pure fundamental research activities, they may aid in managing the transition
between research and commercial communities, including knowledge transfer between the two groups.

In a similar vein, research into the impact of recognising and leveraging the distinctive knowledge possessed by operator, engineers and executive occupational cultures implementing six sigma continuous improvement programs in mature organisations (Schein, 1996) may assist in the incorporation of occupational culture into process theories of innovation.

### 9.6.5 Diversity and Intra-Group Conflict Theories

This and other researchers would benefit from empirical testing of the applicability of interventions based upon workplace diversity and intra-group conflict theories to inter-occupational tension in CRCs. While a burgeoning literature examines the impact of diversity of gender, race and other visible characteristics, to date scholars have paid scant attention to the management of invisible, but potentially as significant, forms of difference, such as occupational subcultures. Comparisons of assimilation/integration and multi-cultural/differentiation approaches to organisational cultures may have important implications of the outcomes for hybrid organisations.

### 9.7 Concluding Remarks

The results of this research present a picture closer to a state of grafted symbiosis than organisational synergy. The managerial challenge in CRCs appears to be how to bring about a form of symbiosis that supports the goals of all stakeholders.

Governments and their associated national systems of innovation are requesting, if not demanding a shift in research values and attitudes; away from public good and open science, and towards the control of intellectual property through patents and the receipt of monetary rewards rather than recognition. A succinct definition of commercialisation illuminates the tensions displayed in some commercialisation organisations. If commercialisation is the *practical application* of *new knowledge*,
then it follows that the people involved have a dichotomy of skills and divergent motivations and occupational cultures. Commercial occupations focus on one idea, remove risk, monitor product development and police project schedules with the aim of making money. Researchers pursue the novel, with the motivation of making knowledge, gaining recognition and thereby ensuring their continued ability to explore new territory.

This research has shown that occupational subcultures exist and influence the outcomes of commercialisation phases of innovation in Australian CRCs. The existence and impact of occupational subcultures in the CRCs explored suggest a differentiation perspective of organisational culture is dominant and supports the three perspectives of organisational culture (Martin, 1992, 2002; Meyerson and Martin, 1987). Moreover, the research has identified occupation-specific forms of debate as a potential obstacle to commercialisation and pointed to the potential to improve process theories of innovation through the accommodation of subcultural differences. It opens up avenues for future research in relation to: hybrid industry-research organisations, theories of hybrid organisations, organisational and occupational culture and innovation theory.


Appendix 1

Sixth International CINet Conference Paper
Brighton, UK, 4 -7 September, 2005.


Preliminary Findings of an Investigation into Interactions Between Commercial and Scientific Occupational Cultures in Hybrid Research Organisations.

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Abstract
This paper reports on the exploratory phase of a qualitative research project that investigates interactions between industry and academic personnel engaged in bringing an innovative product or service to market. This research takes a ‘nexus’ view of organisational culture by investigating the linkages between and within organisational subcultures. Semi-structured interviews centred around experiences of distinctive occupational norms for scientists, engineers and managers, and their perceived potential to facilitate or obstruct the commercialisation process. We confirmed the existence and explicit manifestations of occupational subcultures at work in hybrid research organisations. Some cultural boundaries appear to be based upon educational attainment, motivation tendencies towards money-making or knowledge production, and attitudes towards priorities and timeframes. In addition, the interviewees confirmed that these occupational boundary constructs can impact the outcomes of commercialisation.

Keywords: Occupational Subcultures; Qualitative; Commercialisation; Boundaries

The researchers would like to thank the participants for their generosity in allowing us to benefit from their time and experience. In addition, we thank Dr Ann Dadich for her valuable comments and suggestions.

1. Introduction
This paper reports preliminary findings from the exploratory stage of a research project investigating interactions between commercial and scientific occupational groups. Exploratory interviews were conducted as part of an emic-etic approach to developing semi-structured interview questions consistent with best-practice recommendations for cross-cultural research (Schaffer & Riordan, 2003). We argue that
scientists, engineers and managers have distinct subcultural characteristics that can influence the commercialisation of an innovative product or service. Preliminary findings confirm distinct differences between occupations in terms of boundaries constructed through differing attitudes to time, education and knowledge production.

Commercialisation, or transforming an innovative idea into a marketable product or service, is costly, time consuming and extremely difficult. In fact, the likelihood of any one commercialisation venture becoming successful is so rare that it has been described as a statistical outlier (Matthews & Frater, 2003). Organisational aspects of commercialisation have been studied by scholars through structural foci, such as the size, funding and age of the organisation using both qualitative and quantitative methods (Davenport et al., 1999; D. O. Gray et al., 2001; Lehrer & Asakawa, 2004; Liyanage, 1995a; Liyanage & Mitchell, 1993).

Recent work (Riedlinger et al., 2004; Siegel et al., 2004) has examined commercialisation processes from the point of view of intermediaries, such as communication specialists and technology transfer officers. Although these studies did not start with an explicit intent to consider the impact of culture upon commercialisation, the findings suggested that differences in the norms and values possessed and exercised by occupational subcultures may affect commercialisation processes and outcomes. Hence, questions arise concerning if and how occupational subcultures affect commercialisation processes and if the formation of occupational subcultures has managerial implications for reaching organisational goals.

1.1 Hybrid Industry and University Research Organisations.

The commercialisation of innovative ideas and products is vital to advanced economies that increasingly rely upon their intellectual capital to build a competitive advantage. Across the globe, governments are making sizable investments in attempts to encourage and improve their national systems of innovation. The organisational context for this paper consists of hybrid organisations composed of academic, public sector and commercial personnel, partly funded by the Australian Federal Government’s Cooperative Research Centre (CRC) Programme. Established in 1990 to improve the effectiveness of Australia’s research and development effort, the CRC programme emphasises close interaction between scientific and commercial organisations to guide efforts towards utilisation of research and commercialisation. The Australian Federal Government is investing $5.3 billion from 2005 to 2011 in science and training programmes (Department of Education Science and Training, 2004a). The CRC Programme component of this investment is funded at approximately $220 million each year.

Politicians have viewed the CRC programme as a limited success, and there are clear signals of an increased governmental focus upon CRC profit generation. The political objectives applied to CRCs include pressures to predict and demonstrate paths to commercial adoption; maintain Australian ownership of Intellectual Property (IP); act as training grounds for postgraduate students; and to establish themselves in regional areas, rather than cities (De B拉斯, 2004).

In addition to the ambivalent political assessment, a report on the evaluation of the cooperative programmes reported that approximately 33% of industry respondents indicated problematic researcher collaboration in CRCs (Department of Education Science and Training & Howard Partners, 2003). This may be indicative of polarisations between and within occupational groups. Therefore, further investigation of organisational culture and occupational culture in hybrid organisations is warranted.

2. Organisational Culture: Management Tool or By-product?

While culture is an abstract concept, most people are familiar with the notion of national culture, and could contrast Australian culture with Japanese culture without needing a definition. Goodenough (D’Andrade, 2001) provided a definition of societal culture as “Whatever it is one has to know or believe in order to operate in a manner acceptable to its members”.

Culture viewed as a social construct provides fertile ground for debate about its exact definition. Martin (2002) has provided a comprehensive review of the parameters that generate debate. The points of debate include whether culture is based purely on ideas, solely upon material manifestations, or a mix of the two; whether a broad or narrow range of cultural manifestations should be included in any definition or study of culture; whether a deep interpretation of physical manifestations is required in order to uncover unconscious assumptions or if cultural artefacts should be simply accepted for their superficial meaning; whether cultures have to be shared by some group of members; and, if they are unique from every other culture. The definition of culture used in this research accepts that culture involves both ideas and expressions of those ideas. Organisational culture is considered to represent shared and unique networks of meaning and is best understood through studying a broad range of manifestations in depth.

Interest in the idea that organisations may hold distinctive cultures became apparent in the late 1970s. The publication of “In Search of Excellence: Lessons from America’s Best Run Companies” (Peters & Waterman, 1982) combined with management texts attributing Japan’s strong economic performance to the
organisational culture of large Japanese firms resulted in a view that managing culture could and should be a managerial competence.

The functional or managerialist view assumes that culture can be managed and has a causal relation to the performance of a company. Functional writings from the USA dominate the field of organisational culture, with eighty per cent of published studies written with the conviction that culture can be built or modified to influence business results (J. Martin, 2002). However, while the advantages proposed for “strong cultures” attracted managerial interest, empirical assessments of the performance of the companies praised as the embodiments of strong culture did not support the claimed link between strong culture and strong financial results (J. Martin, 2002).

Furthermore, when organisational culture is considered in studies of innovation, it is primarily viewed from an integrationist perspective, assuming consistency of values and beliefs across an organisation (Deal & Kennedy, 1982; Kotter & Heskett, 1992; Peters & Waterman, 1982). For example, entire organisations were identified as exemplars of innovation culture, despite known subcultural differences amongst its members. Moreover, the literature describes systems of innovation that are compared and contrasted across nations and continents (Lehrer & Asakawa, 2004), assuming organisational cultural homogeneity exists within the boundaries of nations or even economic communities.

In contrast to the functional view of culture, the symbolic view of organisational culture considers culture as a context-specific metaphor, offering no opportunities to influence productivity or force change (Fitzgerald, 2002; Meyerson & Martin, 1987; Trice & Beyer, 1984). Furthermore, Kunda (1992) proposes that efforts at normative control may prove to be self-defeating, producing an environment populated by deeply cynical actors, skilled in presenting the expected behaviour but with decidedly ambivalent feelings towards the organisation (Kunda, 1992). It is the authors’ belief that organisational culture may well be a variable that can be moderated, and, at the same time, organisational culture is also a by-product of the social construction that is unique and shared in that organisation. This is consistent with Martin’s view (2002) who describes at least three different organisational culture perspectives: the integration perspective, the differentiation perspective and the fragmentation perspective.

Proponents of the integration perspective generally accept the idea of “strong organisational culture” (Meyerson & Martin, 1987). They focus on cultural manifestations that have consistent interpretations and regard culture as a clear consensus without ambiguity. The integrationist view of culture supports the “functional view”, which regards culture as a variable that can be changed to affect performance. The differentiation perspective focuses on cultural manifestations that have inconsistent interpretations, and result in certain organisational groupings. The differentiation perspective considers consensus to exist only in subcultures. Subcultures may exist in harmony, independently, or in conflict; however, within a subculture there is clarity. In the differentiation view, uncertainty exists in the spaces between subcultures. The fragmentation perspective claims that relations between cultural manifestations are neither clearly consistent nor inconsistent, but rather, ambiguous – and this ambiguity is the core of culture. Using the frame of fragmentation, consensus is transient and issue specific (Martin, 2002).

Additionally, integration, differentiation, and fragmentation are not mutually exclusive, but co-exist, at varying degrees, within an organisation’s culture. Although one pattern may be relatively more dominant and evident, environmental changes will cause this pattern to recede, allowing others to emerge (Meyerson & Martin, 1987). However, for the purpose of this paper, a dominant view of the differentiation perspective is adopted in relation to hybrid public and private sector research organisations.

2.1 OCCUPATIONAL SUBCULTURES IN INNOVATION

Subcultures are defined as groups that have unique patterns of values and behaviours, providing a distinctive identity, not necessarily inconsistent with the dominant culture of the organisation (Trice, 1993). Every large organisation consists of potential subcultures based on characteristics of gender, ethnicity, profession, age, functional division or geographic location, wage levels, and employment status (Greenberg & Baron, 1999; Kunda, 1992).

The nexus approach to the study of culture supports the concept of subcultures, viewing the organisation as a receptacle for a variety of subcultures imported from its environment (J. Martin, 2002; Meyerson & Martin, 1987). Nexus can be defined as the connection between members of a group or items in a series, and thus suggests the need to study cultures in organisations, rather than organisational culture. Within this view, boundaries of organisational culture are not viewed as stable or distinct. Instead, organisations are deemed pluralistic, composed of subcultures. The occupational subcultures of professions such as nurses and computer programmers may be stronger than the culture of the organisations in which they are employed, particularly if they often move between employers but do not change their occupation (Martin, 2002).
Contributions from the history and sociology of science suggest that a scientific culture exists and, consistent with the nexus view, maybe imported into an organisation to function as a distinctive subculture. Scientists have been identified as members of a distinct occupational subculture, insulated from their social milieu, bound together by a common language, and judged only by peers (T. S. Kuhn, 1977; Tullock, 1993). Earlier sociological studies proclaimed scientists’ behaviour to be subject to institutionalised norms, including the uncontrolled sharing of findings, universalism, disinterestedness, and organised scepticism. These norms are internalised through socialisation and training; they are reinforced by systems of rewards and sanctions; and they are viewed as essential for the pursuit of certified knowledge (Cole, 1992; Gieryn, 1999; Steiner, 2000).

By definition, CRCs are composed of groups with different skills, including commercial skills. Consequently, potential exists for occupational subcultures to exist within CRCs and to impact commercialisation outcomes. This study makes an original contribution to knowledge. It uses non-integrationist perspectives to examine the impact of occupational subcultural interactions on the outcomes of commercialisation as perceived by managers, engineers, and scientists directly engaged in commercialisation activities. Far from being solitary, commercialisation involves teams (Steiner, 2000) consisting of members of specialised communities of practice (T. Kuhn, 2002). Additionally, commercialisation is characterised by communicative and iterative processes (Rogers, 1996).

3. **Methodology**

This paper concerns the exploratory phase of a larger study. Both qualitative and quantitative research methods have been used to study research organisations composed of public and private sector personnel (Davenport et al., 1999; (D. O. Gray et al., 2001) Lehrer & Asakawa, 2004; Liyanage, 1995b; Liyanage & Mitchell, 1993; Riedlinger et al., 2004; Siegel et al., 2004). However, the impact of occupational subcultures of scientists, engineers, and managers upon commercialisation outcomes does not appear to have been directly examined in the existing body of work.

A semi-structured approach was used given the complex social system that was explored. A CRC typically consists of individuals from a variety of professions who are aligned with a particular industry, located within a broad context of Australian society and public research policy decisions. The ability to effectively identify, isolate, and accurately measure both dependent and independent variables within a natural setting is limited. The scant literature on occupational cultures within industry-academic research partnerships would not support attempts to define dependent and independent variables. As social activities occurring within organisational and national cultures, commercialisation processes suit holistic investigation using qualitative methods.

As part of a combined emic-etic approach to developing questions for use in semi-structured interviews, exploratory interviews were held with members of three occupations concerning their experience and perceptions of commercialisation. Combining emic knowledge (concepts considered to be meaningful by members of the organisations and occupational cultures being studied) with etic knowledge (concepts regarded as meaningful and appropriate by the community of external observers) provides opportunities to prepare questions that either accommodate or explore differences between groups. This is consistent with best practice recommendations for cross-cultural methodologies (Schaffer & Riordan, 2003).

To explore awareness of occupational groupings that have diverse values and beliefs about the commercialisation process, three informants were interviewed – a scientist and an engineer from a company that evolved from the CRC Programme and a manager with extensive innovation expertise and experience. Semi-structured questions were used to identify group characteristics – both visible (for instance, dress codes) and invisible (such as, group norms and beliefs). Particular attention was paid to the perceived barriers to, and facilitators of commercialisation. Also considered was the way in which these related to occupational group membership.

Each interview was recorded and transcribed verbatim. QSR N-Vivo® software was used to aid detailed coding and analysis of the collected research material, facilitating the interpretation process. Through the analytic phase of the project, the research material was found to cluster around a number of core themes. Through a reflective, iterative process, we interrogated theme content to explore relationships between and within the themes.

Despite the suitability of the selected methodology, the research findings depend upon the memory, insightfulness, and honesty of the interviewees. The findings are also constrained by time, place, and the changeable nature of individual perspectives. Consequently, the findings cannot be readily extrapolated into other contexts.

However, as the following section illustrates, the insights given by these three interviewees seem to confirm theoretical underpinnings of subculture formation in organisations aligned with distinct occupational
groupings. Therefore, further research into occupational culture, occupational identity, and commercialisation processes in the context of CRCs in Australia is appropriate.

4. CULTURES AND SUBCULTURES IN HYBRID RESEARCH ORGANISATIONS, RESULTS AND ANALYSIS

The interviewees demonstrated clear familiarity with the research topic. They described visible signs of occupational groupings working in commercialisation; the values and beliefs of particular cohorts; and perceived boundaries between commercial and scientific occupational subcultures. Such ability to rapidly grasp and articulate the notion of occupational subculture might be attributed to acumen and education. However, the emotionally charged responses, tinged with anger and frustration, suggests that the personal impact of inter-occupational interactions in commercialisation extends beyond intellectual awareness. This is illustrated in the subsequent sections.

4.1 ORGANISATIONAL CULTURE OF CRCs: UNIQUE AND SHARED ELEMENTS

Each CRC organisation has a unique fingerprint, distinguished by its mix of personalities, skills, and resources that are drawn together for a particular project, for a fixed period. The temporary nature of a CRC is explicit. Funding is provided in seven-year cycles, and secondment from universities and other public sector research organisations, such as the Commonwealth Scientific Industry Research Organisation (CSIRO), is often used to populate CRCs. Awareness of the impermanence of employee involvement, and likely return to their previous employer, may increase occupational barriers. When asked about the temporary nature of employment and the consequences for commitment in CRCs, the scientist responded:

"Definitely in so far as I didn’t have the power to hire or fire any of the people employed by the partner companies so that meant that as a Director of a CRC you could have a CSIRO person go back to Mum. And all that did was create people issues, so it was a very, very difficult role trying to run one insofar as you ended up with the responsibility for having a positive outcome when everyone else was in there for their own interests."

This statement indicates different levels of commitment and loyalty within CRCs. Challenges to the authority of CRC managers are potential contributors to their frustration with the perceived motivation of some CRC members on secondment from academic and governmental institutions. Additionally, the responsibilities of satisfying academic publication targets and simultaneously produce commercial outcomes, may cause CRC members to feel caught between two incompatible systems of measurement. As the manager commented:

"So they are immediately working in a conflicted environment where they may find that they’re directed to work on something which is oriented towards the needs of a company that the university has contracted with... and they’re not getting opportunities to be published. There are some real issues there ... they[scientists] are missing out on the opportunities to publish and to progress within that system."

The statements above indicate a level of consensus about building a strong culture supporting managerial and academic outputs. However, in reality, different occupational group members expressed concern about the likely conflict between these two organisational goals. Hence, the interviewees proposed a functional view of culture, assessed by executive management and changed as required to reinforce organisational goals. This was confirmed by the engineer, who stated:

"...if anything they [the executives] were trying to change the culture, the guy who hired me was very much of the opinion [that the]... scientists involved had very little motivation to actually finish doing scientific work and turn it into a commercial product ...So I was actually brought in to work the way he knew I would work rather than work the way that would fit into the CRC."

The above excerpt suggests that CRCs possess a unique culture, shaped by the temporary employment of its members. Some executives seem to recognise the problems associated with impermanence in these hybrid organisations, and attempt to adjust the organisational culture through recruiting those who are commercially focussed. Therefore, members of a subculture maybe imported for the purpose of organisational cultural change, in addition to their occupational skills.

4.2 DIFFERENT WORLDS

Consistent with the nexus view and differentiation perspective, the interviewees described visible symbols and attributed beliefs and values to members of distinct scientific and commercial subcultures. Interviewees reported the use of physical signs to declare and reinforce group identity. These include the use of space, modes of dress, such as the wearing of white laboratory coats, and occupation-specific meetings.
Invisible but inferred values related to education, different motivations (for instance, money making or knowledge creation), and the importance attached to meeting goals by a specified time. These values are discussed in the following sections.

4.2.1 **Education**

The interviewees collectively viewed science as a closed community. There are stringent entry criteria, and community members are subject to rigorous peer review. Furthermore, transgressors against the scientific value system are punished through expulsion. The scientist and the engineer clearly identified a strict scientific hierarchy within the organisation, based on educational qualifications. The scientist remarked:

“Now the monks did live, and so do the scientists, according to an incredibly tight regime, ... science is incredibly strict. So the idea of science being a tra-la-la freedom to act, it isn’t! It’s hierarchical beyond anything you would expect.”

According to the engineer, educational attainment featured as a method of establishing rank within and between occupations:

“... most of the lab assistants were post-doctoral fellows with PhDs and in excess of 30 or 40 papers to their name and I felt somewhat intimidated as a single-degree engineer, trying to get them to do things which they thought were far beneath them, but to me [it] absolutely had to be done.”

Educational differences translated into separate and differently furnished working environments located within the same building. The engineer referred to the scientists as “superstars”. By contrast he termed members of commercial occupations “grunts”. The engineer also described physical separation between occupational groups:

“...they [engineers and scientists] were kept in different parts of the building...with like air-locks between them (laughing). It was set up that way. You had the operations area over here, then you had a long, skinny corridor with a couple of doors and then you had the scientists...it was real engine room stuff, with the bridge and the engine room. The seating density was much higher in the operations group, [but] nice and big up at the other end, and they [scientists] had embedded coffee rooms and things like that. It was wall offices and lots of glass. There was a blue collar/white collar thing. I don’t know whether that was intentional or it was the way the place grew”

While the engineer considered the physical division unintentional and a consequence of moving into existing offices, the scientist suggested otherwise. In fact, the scientist stated it to be a deliberate attempt to “not mix the two worlds”.

At an inter-occupational level, it appears that perceptions regarding the importance of postgraduate education are associated with condescending communication. The interviewees volunteered “arrogant” as a descriptor of the approach of scientists when dealing with either commercially employed people or commercial processes. Consequently, education, and in particular postgraduate education, appears to be a potential boundary construct worthy of exploration.

4.2.2 **Motivation**

At an individual level, interviewees described increased recognition from scientific peers, coupled with a desire to create knowledge, as motivations for scientists. The interviewees agreed that scientists focus on publication, rather than moneymaking. The manager stated:

“The scientist’s mind set ... is an absolute belief in the value of science and ... a complete lack of understanding about the degree to which publicly funded science ought to be competing for funds.”

At an organisational level, the interviewees described scientific agencies as motivated by government funding. In addition, they perceived that funding allocations were being used to coerce scientists to work outside their customary institutions. One interviewee explained:

“They wanted the [government] money back, which was “rightfully theirs” ... the universities and CSIRO ...if the whole thing fell in a heap, great.”

The above statements indicate a divide between managerial and scientific subcultures. Individual scientists appear to place little personal value on moneymaking, while research organisations are engrossed in attracting funds to ensure survival.
One interviewee commented on changes to the perceived status of scientists. In particular, he felt that while entering a scientific profession had once increased social standing and provided opportunity to benefit society, this appeared to be no longer the case:

“...kids were able to greatly enhance their social status by getting a PhD. ... It's almost a mechanism for social demotion these days.”

In addition to prestige and the pursuit of knowledge, one interviewee advised that security of employment was a key motivator for Australian science graduates. This is due to the scarcity of employers for people holding PhDs in scientific disciplines, as well as the few governmental agencies still hiring researchers. Consequently, there are different attitudes about employment security and employment flexibility. The manager commented on the differences between PhD graduates and other organisational members:

“PhDs who are working in industry don’t have the same attitude to security that the people inside do: there’s more flexibility there and you will find people working in industry will have worked for many more organizations, they [are more able to] change.”

Differing motivations for participation in CRCs appear to exist between individuals and between organisations. The range of motivations, combined with the temporary nature of CRCs, suggests that any assumption of shared organisational goals for individual participants and organisations may have limited validity.

4.2.3 **TIME: PERCEPTIONS OF PRIORITY AND TIMED GOALS**

The concept of time in relation to project management and its impact upon priorities, appears to form a definitive boundary between scientists and commercial groups. In particular, interviewees discussed the importance of meeting commitments regarding the delivery of prototypes. Both the engineer and manager viewed scientists as generally slow to respond to commercial requests. Further, when scientific organisations were involved, the imposition of formal processes created unacceptable delays. The manager stated:

“...I phone up the guy who runs it and tell them what I want done and it was done by Thursday. In contrast [a public sector science organisation] ...took 10 weeks before we exchanged paper work where they were happy to actually talk to me ... So there’s some big gaps between the culture in that sector and the culture in industry.”

The engineer contrasted the production of a reliable end product by the agreed delivery date (by commercial members of the CRC) and the attraction to creativity, novelty, and knowledge creation (by scientists):

“They [scientists] didn’t like repeating anything. Once they had done a scientific experiment... that was it and there was no longer any interest in it. To turn it into a commercial product you need it to be repeatable. So yeah, there was a lot of head-banging at that stage.”

This suggests that different norms shape the value placed on scientific exploration, as opposed to the production of a punctual end product. These values were considered to also shape decisions about priorities, and the roles of key players within the project schedule. In a similar style, the engineer did not view seminars, held to keep scientists current with latest research in their field, as valid work or an efficient use of time:

“There were meetings that only scientists used ... it’s like a university common room culture ... They would sit in and talk about latest discoveries in the field, it was just a big chinwag.”

These meetings constitute occupational rituals. They bring to the fore contrasting views of work as practices that increase knowledge or produce a monetary outcome within a fixed timeframe. The interviewees concurred about the different interpretations of, and values placed on time-related events between commercial and scientific groups – particularly, deadlines. There thus appear to be disparate views about temporal events between scientific and commercial occupations – an apparent manifestation of dissimilar beliefs and norms.

4.3 **OCCUPATIONAL SUBCULTURES AS FACILITATORS OF, AND BARRIERS TO COMMERCIALISATION**

Commercialisation is, by definition, a multidisciplinary activity. As a subset of the broader process of innovation, preparing a product for sale involves significant development, design and testing, after the initial discovery (Science and Innovation Mapping Taskforce, 2003). It also involves specialised knowledge of financial markets, distribution, and marketing. Different skills are required to prove the potential feasibility of a product or service and then bring it to market launch.
Complementary roles that support and value the use of symbiotic occupational skills predict constructive interactions. According to the engineer:

“In my career I have found that generally engineers don’t envy scientists and scientists don’t envy engineers. They’re quite happy you know that “I make products, I don’t investigate ideas.” And scientists go “How boring! All you do is make products, you don’t think about things.” There’s not much conflict, there’s a nice separation there.”

The interviewees clearly identified separate subcultures, distinguished by different behaviours and beliefs about education and motivation, as well as compliance with schedules. Thus, occupational subcultures with separate conventions, forms of address and dress, and differing beliefs, does not necessarily augur badly for productive commercialisation.

However, the interviewees clearly expressed that conflict between commercial and scientific subcultures could, and often did, occur. The scientist reflected on organisational cultural tensions between scientific creativity and corporate concerns of control and cost, when he was describing a pharmaceutical company’s attempt to coopt academic researchers:

“…they’re oscillating between “Oh we can’t deal with these unruly scientists, we’ll bring it inside.” And “Oh, nothing is happening, we’re spending money and there’s no inventiveness.””

The scientist perceived widespread barriers to commercialisation, as a consequence of a lack of understanding of scientific culture on the part of commercial personnel:

“What people have not yet fully embraced is how to bring those two together and you can see that business and engineering are frequently failing, because they do not have sufficient understanding … of the rigour and toughness of the [scientific] world.”

While the engineer was partly motivated by personal recognition, he clearly viewed “success” to depend on how quickly the venture would produce revenue:

“…for all the people you brought in for the operations side [the motivation] was money. It was money you know, and … that’s OK because for me I walk in and in less than a year I’ve made a name for myself and done a great thing.”

Furthermore, different values placed on money and moneymaking appear to exacerbate the status degradation within the scientific community. Using a strong metaphor, the scientist described a “slave market” filled with scientists being bought by managers according to their commercial potential:

“…there’s a new batch of slaves has come in and he who grabs them first gets them.”

This personal insight suggests that the potentially destructive tensions between scientific and commercial cultures may have been overlooked in public policy creation. The image of a slave market offers an interesting counterpoint to the title of Lehrer and Asakawa’s (2004) review of economic policy, “Pushing Scientists into the Marketplace: Promoting Science Entrepreneurship”.

In addition to occupational orientations towards moneymaking, dissimilar notions of time and commitment were thought to divide occupations and thwart commercialisation:

“… the people who were in operations, all came in quite excited … they were all running around like mad things …. The scientists didn’t seem to be overly worried. They knew they had life-time security … they had an uplift in salary … there was no risk for them so they had no pressure at all. So there was a completely different attitude, … feverish activity on the side of the people who had come from a commercial environment, knowing, … you had to make something before you go out of business and the scientists were just happily living away in CSIRO culture.”

This excerpt suggests that some members of commercial occupations believe that their career and reputation are at risk if the commercialisation venture is not successful, but scientific personnel do not suffer any adverse consequence. Such interpretations are possibly exacerbated by the impermanence of the organisation, as well as the knowledge that scientific members would return to their previous employer, while their commercial counterparts had no “safety net”.

Finally, the engineer described the contribution of educational differences to the development of a competitive relationship as follows:

“The operations executive didn’t have anything close to the academic qualifications that the technology executive of the CRC would consider being adequate …The operations executive thought the people in the technology area had nowhere near the commercial savvy required … That could have been seen as a collaboration but it turned into a confrontation often…”

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Attitudes of mutual disdain were reported to be entrenched in commercial and scientific occupations. This is indicated by the parameters that surround occupational membership of the “grunts” or “superstars”, rather than loyalty to any particular leader.

In summary, the exploratory interviews supported the idea of a *nexus*, whereby subcultures are imported into scientific and commercial hybrid research organisations. The interviewees, who are members of those subcultures and possess commercialisation experience, described distinct subcultures, which are broadly based upon membership of commercial or scientific occupations. These emic insights point to postgraduate education, perceptions of time, and perceptions of motivation as three potential boundary constructs for the occupational subcultures. These in turn, may affect the introduction of innovation into the market.

5. **Discussion and Conclusions**

Exploratory interviews with a manager, scientist, and engineer provided an opportunity to combine insider knowledge with theory to create and tailor research questions for a larger study. An analysis of the research material allowed for themes to emerge, as the interviewees constructed their own meanings of situations through the interview process. Specifically, the research material was found to cluster around a number of core themes. Three clear themes related to education, motivation, and time. These themes, amongst others developed from emic knowledge, were used to develop a semi-structured interview schedule to further explore the existence and forms displayed, boundary constructs, perceptions of impact, and the constructive management of occupational subcultures in commercialisation.

The exploratory interviews confirm subcultural differences between occupational groups engaged in commercialisation. Physical manifestations of subcultures included use of space, ritual, and dress. The scientific group was viewed as very distinct, with comments about scientific culture and practice occurring frequently. Inferred values, such as the high value placed upon academic qualifications and publication record, appeared to be consistent with existing literature regarding scientific culture. The identification of a scientific subculture supports the differentiation perspective of organisational culture theory.

The exploratory interviews also suggest that changes to government funding decisions are being perceived as communicating a desire to modify scientific culture. This is indicated by the scientist’s view that some CRC members regarded the funding allocated to the CRC as “rightfully theirs”. However, established scientific norms, including the free sharing of findings and the desire for peer recognition, do not appear to be easily reconciled with commercial desires for secrecy, control, protection of intellectual property, and monetary rewards.

Furthermore, occupational subcultures have the potential to act as barriers to, or facilitators of the outcomes of commercialisation efforts. The emphasis placed upon the reliability, predictability, and viability of a product by the engineer and manager appear to be at odds with the scientist’s attraction to creativity and novelty. This suggests that different norms affect the value placed on scientific exploration, compared to the production of an on-time end product according to occupational membership. It also illustrates one of a number of potential barriers based on occupational subcultures. 

Previous findings regarding the desires of industrial researchers for strategic autonomy (control over ends) and operational autonomy (control over means) may be particularly useful (Bailyn, 1985). They may hold explanatory value for the barriers based on interpretations of priorities and timed goals. Scientific work directed to achieve commercial goals reduces strategic autonomy available to researchers. If commercial managers also set project schedules and deadlines for delivery, then scientists forfeit key elements of operational autonomy as well. Subordination to commercialisation strategies and timeframes is likely to challenge the norms of an experienced researcher on secondment from a setting such as a university where researchers are accustomed to choosing research goals and controlling the research process. Consequently, it seems possible that hybrid research organisations, populated by academic secondees, are likely to experience conflict in relation to the interpretation of priorities and assignment of project milestones.

The research material suggests that occupational subcultures, broadly based upon membership of scientific or commercial groups, can be made explicit. Commercialisation, as a subset of the innovation process, requires the contributions of members of scientific, technological and managerial occupations to create new configurations of products, markets, technology and organisations. The research focus upon organisational subcultures present in temporary hybrid research organisations provides examples of some challenges that may impede the interdisciplinary collaboration required for successful continuous innovation. Research to continue the exploratory work reported in this paper is underway and is expected to conclude in 2007. Investigating interaction between organisational subcultures in CRCs, and its affect on the commercialisation process, will contribute to both organisational culture theory and facilitate effective commercialisation management.

Despite the value of the preliminary findings, a number of methodological limitations must be considered. For example, the cross-occupational nature of this project indicates that the interviewees merely provide a
snapshot of the Australian context. It is also recognised that qualitative research is limited by time and the nature of individual perspectives. Additionally, the use of convenience sampling to invite the participation of one manager, one scientist, and one engineer may have biased the present findings. The interpretive approach used to analyse the research material should also be acknowledged. The findings reflect the interaction between the research team and the interviewees. They also reflect the research team’s interpretation of these interactions, and are thus tainted by the frames the team members bring to the project. The construction of themes from the interview material may therefore not adequately encapsulate the perceptions voiced by the interviewees.

Nevertheless, the research findings are consistent with those in the existing body of relevant literature. They therefore pave the way for future research on distinctive cultural forms that characterise occupational subcultures engaged in commercialisation, occupational boundary construction, and reinforcement. Further research is also warranted around the impact of occupational subcultures on work in hybrid organisations that bring innovative products or services to the market.

In conclusion, this paper confirms the existence of at least three boundary constructs: educational background, the apparent dichotomy of money-making versus knowledge making, and perceptions of priorities and timed goals. The findings also confirmed that subcultural distinctions could act as barriers or facilitators for commercialisation. Building an enhanced understanding of the patterns for behaviour between and within occupational subcultures in Australian CRCs may positively contribute to “ways of making things happen” in the commercialisation process. Therefore, further investigation into interactions between scientific and commercial subcultures in hybrid research organisations is warranted.

REFERENCES


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Business and Scientific Forms of Argumentation in Commercialization:
Dictators and Chinwaggers.

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Abstract- Commercialisation activities combining the discoveries of one occupational group, such as scientists, with the commercial skills of engineers and managers involve interactions across occupational cultures. This paper considers how dissent can be interpreted as a sign of dysfunction or cause for concern. The context of the study is Australian hybrid research organisations comprised of academic, government and industry personnel. Semi-structured interviews of a total of twenty scientists, engineers and managers focussed on their experiences and perceptions of occupational norms, including styles of debate, and the potential of these norms to facilitate or obstruct commercialization. Distinctive patterns of argumentation were identified as typical of commercial and research occupations. In addition, the interviewees confirmed that occupational forms of argumentation could influence the outcomes of commercialization.

I. INTRODUCTION

This paper considers how members of commercial occupations can interpret ritual dissent, considered to be a normal and constructive mode of interaction by members of scientific occupations, as a sign of conflict and cause for concern. Commercial occupations include commercially oriented engineers and business managers. The context for the study is hybrid research organizations in the Australian Cooperative Research Centers (CRC) program. CRCs are composed of academic, government and industry members working together to bring an invention to market. We argue, based on interviews with scientists, engineers and managers that the styles of argument used in occupational groups within hybrid research organizations may act as a barrier to
commercialization. Analyzing different argumentation styles extends existing research into occupational norms of debate.

Innovation generally involves the practical application of new knowledge. This involves at least two types of occupational cultures encompassing the pragmatic, systematic, roles filled by a variety of commercial occupations, and the exploratory roles performed by “pure” researchers. Consequently, tension between two types of occupational cultures may be implicit in innovation. Commercialization activities combine the discoveries of one occupational group, such as scientists, with the commercial skills of engineers and managers [1]. Therefore, bringing innovative ideas to emerging or established markets involves interactions across occupational cultures [2].

In hybrid research organizations, argumentation, which we define as the action or process of reasoning systematically in support of an idea, is a common interaction between occupations. For an extensive review of argumentation theory see [3]. The scientific form of argumentation, characterized by logical reasoning about competing ideas, has been identified as poorly adapted to public debate of trans-scientific social issues such as global warming [4]. Although scientific and academic groups are skilled in and accustomed to using constructive dispute to produce creative ideas and outcomes, occupational norms which proscribe dissent may restrict their effectiveness in cross functional groups. Conversely, the value of minority opinions and constructive dissent in increasing group creativity while guarding against “groupthink” is well documented [5]. Members of business cultures which in the main value cohesion and conformity [6] may view signs of scientific disagreement as alarming and predictive of failure.

The use of language, dialogue and argumentation is an occupational culture construct, policing acceptable communication within the group. Far from being an outmoded form of rhetoric at risk of extinction, scientific argumentation plays a vital role in the creation of knowledge. Programs to measure and increase the teaching of argumentation in school science are being implemented in the UK [7]. Yet little attention has been directed to the potential impact of different norms for debate and discussion upon commercialization phases of innovation or the outcomes of hybrid research organizations.

Culture and Innovation

When organizational culture is considered in studies of innovation, integrationist assumptions of consistent values and beliefs are often made [8]. For example, entire organizations are identified as exemplars of innovation culture, despite known subcultural differences amongst its members. Moreover, the literature describes systems of innovation that are compared and contrasted across nations and continents [9] assuming organizational cultural homogeneity exists within the boundaries of nations or even economic communities.

In contrast to the integration perspective, the differentiation perspective [8] focuses on cultural manifestations that have inconsistent interpretations, and result in certain organizational groupings. The differentiation perspective considers consensus to exist only in subcultures. Subcultures may exist in harmony, independently, or in conflict; however, within a subculture there is clarity. Recent research has pointed to the existence of subcultures within hybrid research organizations [2, 10].

Subcultures and Innovation

Subcultures are defined as groups that have unique patterns of values and behaviors, providing a distinctive identity. Subcultures can be consistent or inconsistent with the dominant culture of the organization [11]. Every large organization consists of potential subcultures. For example, subcultures may exist based on characteristics of gender, ethnicity, profession, age, functional division or geographic location, wage levels, and employment status [12]. Hybrid research organizations are likely to import occupational subcultures along with the individuals recruited from research, commercial and government institutions. In addition to other group behavioral characteristics, professional and occupational affiliations influence argumentation [3].

Hence, while existing literature acknowledges the functions of argumentation in knowledge creation, it does not necessarily address the difficulties of occupational cultural differentiation within hybrid organizations. This research explores business and scientific forms of argumentation and gives insight into their potential to act as a barrier to commercialization.

II. METHODOLOGY
A qualitative, semi-structured approach was employed. A CRC typically consists of individuals from a variety of professions aligned with a particular industry, located within a broad context of Australian society and public research policy decisions. The ability to effectively identify, isolate, and accurately measure both dependent and independent variables within a natural setting is limited. Also, the scant literature on occupational cultures within industry-academic research partnerships would not support attempts to define dependent and independent variables. As social activities occurring within organizational and national cultures, commercialization processes in a complex social system suit holistic investigation using qualitative methods.

A total of twenty scientists, engineers, and business managers were recruited from Australian Cooperative Research Centers (CRCs). The CRCs’ maturity ranged from newly formed to publicly listed companies developed out of the CRC program. Their experiences and perceptions of differing subcultural norms, including styles of debate, were recorded and transcribed verbatim. QSR N-Vivo software was used to aid detailed coding and analysis of the collected research material, facilitating the interpretation process.

Through the analytic phase of the project, the research material was found to cluster around a number of core themes. Through a reflective, iterative process, we interrogated theme content to explore relationships between and within the themes.

Despite the suitability of the selected methodology, the research findings depend upon the memory, insightfulness, and honesty of the interviewees. The findings are also constrained by time, place, and the changeable nature of individual perspectives. Consequently, the findings cannot be readily extrapolated into other contexts.

However, as the following section illustrates, the insights provided by the interviewees extends existing theory to consider the potential impact of inter-occupational argumentation on the functioning of hybrid research centers. Therefore, further research into occupational culture, occupational identity, and commercialization processes in the context of CRCs in Australia is appropriate.

III. RESULTS AND ANALYSIS

The interviewees demonstrated clear familiarity with the research topic. They described visible signs of occupational groupings working in commercialization; the values and beliefs of particular cohorts; and perceived boundaries between commercial and scientific occupational subcultures. Such ability to rapidly grasp and articulate the notion of occupational subculture might be attributed to acumen and education. However, the emotionally charged responses, often marked by frustration, suggest that the impact of different styles of occupational argumentation in commercialization extends beyond mere intellectual awareness. This is illustrated in the subsequent sections.

Argumentation as an Occupational Norm

Scientists, engineers, and managers from government and private sectors described distinctive patterns of argumentation as typical of different occupations. Descriptions of scientific and academic group debates were consistent with earlier reports [4, 5]. Specifically, restrictions on the amount of time allocated for discussion and expectations of action as the result of debate were very different for commercial and research communities. Both commercial and academic groups agreed that researchers enjoyed debate and viewed it as an important part of their identity. As stated by a scientist, who moved to a management position;

“The important aspect is inquiry into “What’s the best focus?” It’s not inquiry for the sake of “Let’s muck around.” And that’s often the criticism of science going into commercialization. Inquiry is a necessary process before you arrive at an agreed way forward. That’s very stimulating and something I really, really miss in shifting from that culture … difference of opinion is part of the creative process.”

The importance of dissent as a tool to hone solutions through a verbal contest of ideas and as a symbol of scientific identity was evident. When asked if the academic and research members of the CRC enjoyed debating amongst themselves, a public sector manager responded that it was a core part of their professional identity, stating:

“They’ll [scientists] consider [debate] very much part of their reason for existence. And if they didn’t have that debate I think they would see themselves as not representing their profession. …. The debate may well air a range of options and different opinions and approaches and thoughts and so forth but it doesn’t crystallize an outcome. And for the private sector all that debate’s good, but if it doesn’t bring you closer to an absolute outcome, an absolute
decision, well then all it is is debate. It may be very worthwhile from the academic point of view but time is money when it comes to the private sector.”

Sharing the view that business communication should be action-oriented and produce a clear conclusion a product development engineer remarked:

“There were meetings that only scientists used. They had a university common room meeting culture. They would sit about latest discoveries in the field; it was just a big chinwag. And that was work. Because they were scientists...they’d talk about the latest things in the field and if it didn’t relate to the thing I was trying to make I couldn't care less. I used to get dragged along to them occasionally but, operations point of view, meetings to me were a waste of time. I do the communication I need to do as I need to do it.”

Similar comments were made by other participants, indicating clear understanding and acknowledgement of differences in the acceptability of dissent and the desirability of reaching a clear conclusion in a specified time frame. Comments regarding time limits for debate suggest that argumentation norms may be influenced by different temporal orientations towards pace and punctuality in the two broad occupational groups. However consideration of this possibility is beyond the scope of this paper.

Organizational Leadership and Argumentation

In addition to signaling membership in research or commercial subcultures in hybrid research organizations, the use of rational argumentation was identified as a handicap to cross-functional group leadership. Clearly stating all assumptions and relying upon logic to win an argument were viewed as incompatible with the political demands of balancing the needs of public and private stakeholders. As explained by a manager:

“... the current CEO is extremely political in [his] behavior in order to satisfy the conflicting interests of board requirements or stakeholder environments vs. scientific requirements. Getting a scientific person to step into that role and try and manage is near impossible. [laughs] That’s what they’ll try and do. They’ll get in there and say “I’m just going to be straight. And of course you need to be able to balance those two conflicting worlds.”

The manager was quick to praise the skill of the scientist and the quality of their logic and reasoning, but continued:

“...there is no question he uses logic and reasoning to rule the day. That won’t necessarily work in a political environment where one of the conflicts would come up is his employer is sitting around as one of the stakeholders... But he’ll keep going back and use logic and reasoning as opposed to political processes”.

Some of the interviewees managing research groups clearly understood that engaging in scientific argumentation could alarm industrial members of the CRC. After saying that he enjoyed engaging in rational debate with other experts in his field, a manager of scientists volunteered:

“I’m just conscious that if I’m having a debate with scientists, even scientists from [industry member of hybrid research organization], I’m happy to be quite open. Whereas if I’m having a discussion with the business people from the company then I’m going to be much more careful in how I say things so as not to overly worry them about things which indeed are a very small worry, but could be taken out of context.”

Consequently, the style of argumentation employed by members of research or commercial occupations does more than identify group membership. It can impede communication across occupational subcultural boundaries. Furthermore, the interviewees revealed that occupational membership, not organizational affiliation, was the source of differing norms of argumentation.

Participation in Argumentation and Occupational Subcultural Boundaries

Participation in extended bouts of rational argumentation was reported to be restricted to members of groups involved in knowledge creation, whether located in academic, public or private sector organizations. Interviewees spoke of extended and heated, but congenial debates occurring between researchers while commercial representatives present did not participate. Individuals from non-research groups only became involved to stop the debate if they thought it had gone on for too long. A public sector manager described the motivations of business and government representatives present during the debates as follows:

“Private sector, their role tends to be very vested interests, hence narrow focus and short and sharp, not bringing in a whole range of otherworldly thoughts into the
process but short, sharp and focused. From the government perspective, the government input is more generalized than the private sector, whether it’s going to be useful from a government perspective. Not as focused and as to the point as the private sector but still somewhat focused relative to what the academic debate might be.”

There was general agreement that rational argumentation was closed to non-members of research communities, indicating that styles of argumentation may help to create and reinforce occupational boundaries. Tolerance of discussions without time limits and with ambiguous outcomes was identified as an important difference. As a manager commented when asked if rational arguments reached final and lasting conclusions:

“Well sometimes they do. Sometimes they just peter out in the context of “Yes, there’s differing opinion on the subject” and if there’s no categorical resolve well then everyone can go back to their corners agreeing that there’s differing opinions which could be revisited at a later date.”

The norms of scientific argument include a preference for a written format, a well-informed audience, no imposed time limits and little expectation that a “Yes” or “No” conclusion will be reached to support a particular course of action [4]. On the other hand, business decisions have been reported to be based upon preparation that does not conform to the typical pattern of argumentation used in science [13].

Occupation Specific Argumentation as a Barrier to Commercialization

In addition to functioning as an occupational identity construct rational argumentation may contribute to barriers to commercialization. As a scientist explained:

“The clash occurred where …the mode of working within the culture of science is one that’s driven by inquiry, which is driven by brainstorming. The commercial product managers wanted to focus on one approach only and pin it down, no divergence whatsoever. Even the mode of discussion, conversation, engagement, was so different and the commercial guys found it quite threatening and kept saying “Stop arguing.” … by quelling that inquiry it actually reduced the standards, a mediocrity came into the work, an absolute culture change occurred. That difference of opinion is part of the creative process. But it’s viewed as the dysfunctional of the [scientific] group, and sort of a threatening aspect. And a couple of times where I’ve sort of gone into “science mode” of really wanting to understand “Why and how”, has been seen as threatening. Here as well [referring to new employer].

A manager from the same CRC organization offered the following rejoinder when asked about the need for scientists to engage in rational argumentation to identify the best possible solution:

“I generally think that there is a, sensible way forward with a number of options that you can discuss but you should be aware of the options beforehand. And the thing is scientists always say “You don’t know,” and therefore just stop planning for it, which does drive me nuts. … And that’s not really thinking far enough ahead. And that I’ve seen many, many times, that scientists focus on the next few experiments, and being completely unable to handle uncertainty and complexity which is odd given that’s what they should be doing, and I think that is what business does all the time. If you haven’t told somebody something might go wrong and it does, it might be blindingly obvious to a scientist but if you haven’t told your supporters and investors of the possibility then they are certainly going to see vigorous debate as a failure.”

From the perspective of the scientists, attempts by business people to limit debate were dismissed as “micro-management” and indicative of a desire to “dictate” technical solutions to problems they were not qualified to address. Scientists reported dismay and distrust upon hearing business people publicly announce project timeframes based upon what the scientists viewed as a naively optimistic view; that everything would run to schedule. Both commercial and research informants reported business people viewing rational argumentation as a sign of occupational dysfunction, evidence of inadequate forward planning, or suggestive that the proposed solution will fail.

At least three points emerge from the previous discussion. First, argumentation styles can act as occupational and subcultural norms. Second, the use of distinctive occupational argumentation repertoires may not facilitate communication in cross-functional meetings and thirdly, argumentation style may influence perceptions about project statuses and likely outcomes. Thus, the diverse forms of argumentation favored by research and commercial occupations provide a sense of group identity and are suited to their
differing tasks and organizational environments. However, different argumentation styles may reduce the ability

of inter-occupational contributions to commercialization to be accepted and recognized as constructive.

IV. CONCLUSIONS:

How Can the Chinwaggers and Dictators Talk To Each Other?

Argumentation patterns typical of commercial and research groups reveal their occupational values and assumptions. In commercial settings action and results are valued, particularly as a focus on speed as a competitive strategy has become common over the past fifteen years [14]. This leads to argumentation patterns favoring quick decisions oriented towards taking action to achieve short term organizational interests. This commercial argumentation is not easily reconciled with scientific values of accuracy and thorough understanding. Furthermore, popular management texts praising “strong” business cultures that display consensus and conformity [6] may have exacerbated perceived differences between the two groups’ use of argumentation, contributing to commercial perceptions of scientific argumentation as an occupational and organizational problem.

Scientific or academic styles of argumentation are characterized by vigorous dissent to create and continuously improve ideas and not timed while business debates are reported be action oriented, timed and managed to a definite conclusion. In commercial groups, dissent may be perceived as a threat to group cohesion, group hierarchies and the efficient execution of business plans. Scientific groups report enjoying intellectual dissent, consider it to be constructive and value it as a key part of their professional identity. When the groups are separate they can follow their own norms in parallel. When combined in cross-functional teams, encountering seemingly foreign standards for debate can create frustration and may jeopardize commercialization outcomes. Members of each community generally regard the debating norms of the other group as unusual and an obstruction to equal participation, (even to the extent of applying labels such as “dysfunctional”) creating barriers to communication and commercialization. At the same time members of both groups maintain their occupational subcultural boundaries and identity by continuing their distinct argumentation style in a combined forum, even when doing so impedes communication.

The argumentation rituals used by research and commercial groups may reflect their underlying reward systems and motivation towards producing knowledge or making money. Mutual conflict exists between business pressures for speed and punctuality and a scientific emphasis on thoroughness and understanding to protect and enhance scholastic reputations. However, the different forms and norms of debate and rhetoric fit two key roles in innovation: imagining the as yet non-existent product or service and making it concrete. Scientific argumentation plays a complementary role to business modes of debate through the creation and testing of ideas vital in the early stages of the commercialization process. Focusing on a specific approach and organizing the team to fund, test and manufacture in volume to meet set deadlines provides the corresponding applied role.

If members of hybrid research organizations understand and are aware of the norms held and debating rituals practiced by business and scientific occupational subcultures it may be possible to reduce misunderstandings and reduce one obstacle to commercialization. To obtain the benefits promised from the formation of hybrid research groups, it is important that each occupational subculture be free to employ its own subculturally appropriate rhetorical forms in single audience meetings. However a consciousness of differences in styles of debate and modified use of both forms when inter-occupational subcultures meet are likely to be advantageous. Further investigation of interaction between organizational subcultures and its effect on commercialization processes will make contributions to organizational culture theory and facilitate effective commercialization management.

ACKNOWLEDGMENT

The researchers would like to thank the participants for their generosity in allowing us to benefit from their time and experience.

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Appendix 3

Int. J. of Technology Policy and Management Article (in press) 2007, 7(3).

Business and Research Forms of Debate: Argumentation and Dissent as Barriers to the Commercialisation of Innovations in Hybrid Industry-Research Organisations.

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Abstract: Commercialisation activities combining the discoveries of one occupational group, such as scientists, with the commercial skills of managers involve interactions across occupational cultures. This article considers how dissent can be interpreted as a sign of dysfunction or cause for concern. The context of the study is Australian hybrid industry-research organisations composed of academic, government and industry personnel. Semi-structured interviews of a total of twenty scientists, engineers and managers focused on their experiences and perceptions of occupational culture, including styles of debate, and the potential of assumptions and norms to facilitate or obstruct commercialisation. Distinctive patterns of argumentation were identified as typical of commercial and research occupations. In addition, the interviewees confirmed that occupational forms of argumentation could influence the outcomes of commercialisation.

Keywords: Commercialisation, innovation, organisational culture, hybrid industry-research organisations, argumentation

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Anneke Fitzgerald is the Research Studies Programme Coordinator in the College of Business, University of Western Sydney, Australia. Anneke’s research interests include employing mixed methodology in Organisational Behaviour and Organisational Psychology research.
1 Introduction

Since the 1980s, governments of industrialised economies have looked to innovations involving the generation of, and reconfiguration of knowledge as a means of maintaining their competitive advantage (Gibbons et al., 1994). The evolution of “Triple Helix” organisations in which private firms and publicly funded research groups collaborate has been traced across Europe, the USA, Latin America and Asia (Etkowitz & Leydesdorff, 2000). In these hybrid industry-research organisations, the initial stages of knowledge management, including the identification, capture and evaluation of innovations, are increasingly conducted across occupational and organisational boundaries.

This article considers how members of commercial occupations can interpret ritual dissent, considered a normal and constructive mode of interaction by members of research occupations, as a sign of conflict and cause for concern. Commercial occupations include commercially oriented engineers and business managers. The context for the study is hybrid industry-research organizations in the Australian Cooperative Research Centres (CRC) programme.

The Australian CRC programme provides one example of government intervention to stimulate innovation by encouraging collaborative arrangements. CRCs are composed of academic, government and industry members working together to bring an invention to market and operate as trans-disciplinary, temporary organisations intended to link discovery, application and use. Additional policy objectives include the maintenance of Australian ownership of Intellectual Property, provision of training positions for postgraduate students and the inclusion of groups located in regional areas, outside the major cities (Department of Education Science and Training & Howard Partners, 2003).

We argue, based on interviews with scientists, engineers and managers that the styles of argument used in occupational groups within hybrid industry-research organizations may act as a barrier to commercialisation. Analysing different argumentation styles extends existing research into occupational norms of debate to include commercialisation processes and the context of triple helix organisations.

Innovation generally involves the practical application of new knowledge. This requires at least two types of occupational cultures; the pragmatic, systematic, roles filled by a variety of commercial occupations, and the exploratory roles performed by “pure” researchers. Commercialisation activities combine the discoveries of one occupational group, such as scientists, with the commercial skills of engineers and managers (Steiner, 2000). Therefore, bringing innovative ideas to emerging or established markets involves interactions across occupational cultures (K. Hayes & Fitzgerald, 2005), and tension between occupational cultures may be implicit in innovation.

In hybrid industry-research organizations, argumentation, which we define as the action or process of reasoning systematically in support of an idea, commonly occurs in groups composed of more than one occupation. For an extensive review of argumentation theory see Sillince (2002). Rational or scientific argumentation uses logical reasoning about competing ideas, for an extended period, until the topic has been exhaustively analysed. It is important to distinguish between the form of argumentation identified as rational by Sillince (2002) and the rational school of epistemology. Rationalism refers to the Cartesian approach to the philosophy of knowledge, based upon the use of logic and mental constructs to deduce truth. Rational argumentation, as referred to in this article is not limited to Cartesian notions of truth and knowledge. It is equally applicable to empirical approaches based upon induction and sensory experiences (Nonaka & Takeuchi, 1995).

Scientific forms of argumentation have been identified as poorly adapted to public debate of trans-scientific social issues such as global warming (Ziman, 2000). Although scientific and academic groups are skilled in and accustomed to using constructive dispute to produce creative ideas and outcomes, occupational norms that proscribe dissent may restrict their effectiveness in cross functional groups. Conversely, the value of minority opinions and constructive dissent in increasing group creativity while guarding against “groupthink” is well documented (Nemeth, 1997). Members of business cultures, which in the main value cohesion and conformity (Pech, 2001) may view signs of disagreement between researchers as alarming and predictive of failure.
Researchers reading this article in a scholarly journal are unlikely to be surprised by the description of research argumentation norms. As Schein (1996, p. 236) noted:

Norms become a fairly visible manifestation of these assumptions, but it is important to remember that behind the norms lie this deeper taken-for-granted set of assumptions that most members of a culture never question or examine. The members of a culture are not even aware of their own culture until they encounter a different one.

However, this was not the case for the commercially oriented personnel interviewed for this research. In hybrid industry-research organisations, commercial personnel may be encountering research or academic forms of argumentation for the first time. In interviews commercial informants described research styles of debate as “chinwagging” and even “atrocious”. A manager in a CRC in the early stages of formation described exposure to research norms as “a revelation”. What is certainly surprising is that in the multitude of organisational parameters used to explore innovation outcomes (Wolfe, 1994), occupation specific argumentation has been overlooked.

The use of language, dialogue and argumentation is an occupational culture construct, policing acceptable communication within the group. Far from being an outmoded form of rhetoric at risk of extinction, scientific argumentation plays a vital role in the creation of knowledge. Programmes to measure and increase the teaching of argumentation in school science are being implemented in the UK (Erduran et al., 2004). Yet little attention has been directed to the potential impact of different norms for debate upon commercialisation phases of innovation or the outcomes of hybrid industry-research organizations.

Culture and Innovation

When organizational culture is considered in studies of innovation, integrationist assumptions of consistent values and beliefs are often made (J. Martin, 2002). For example, entire organizations are identified as exemplars of innovation culture, despite known subcultural differences amongst its members. Moreover, the literature describes systems of innovation that are compared and contrasted across nations and continents (Lehrer & Asakawa, 2004) assuming organizational cultural homogeneity exists within the boundaries of nations or even economic communities.

In contrast to the integration perspective, the differentiation perspective (J. Martin, 2002; Meyerson & Martin, 1987) focuses on cultural manifestations that have inconsistent interpretations, and result in organizational groupings. The differentiation perspective considers consensus to exist only in subcultures. Subcultures may exist in harmony, independently, or in conflict with other subcultures; however, within a subculture there is clarity. Recent research has pointed to the existence of subcultural differences within hybrid industry-research organizations (K. Hayes & Fitzgerald, 2005; Siegel et al., 2004) and between members of university-industry linking programmes (Plewa & Quester, 2006).

Subcultures and Innovation

Subcultures are defined as groups that have unique patterns of values and behaviours, providing a distinctive identity. Subcultures can be consistent or inconsistent with the dominant culture of the organization (Trice, 1993). Every large organization consists of potential subcultures. For example, subcultures may exist based on characteristics of gender, ethnicity, profession, age, functional division or geographic location, wage levels, and employment status (Kunda, 1992). Hybrid industry-research organizations are likely to import occupational subcultures along with the individuals recruited from research, commercial and government institutions. In addition to other group behavioural characteristics, professional and occupational affiliations influence argumentation (Sillince, 2002).

Hence, while existing literature acknowledges the functions of argumentation in knowledge creation, it does not necessarily address the difficulties of occupational cultural differentiation within hybrid organizations. This research explores business and scientific forms of argumentation and gives insight into their potential to act as a barrier to commercialisation.
2 Methodology

A qualitative, semi-structured approach was employed. A CRC typically consists of individuals from a variety of professions aligned with a particular industry, located within a broad context of Australian society and public research policy decisions. The ability to effectively identify, isolate, and accurately measure both dependent and independent variables within a natural setting is limited. In addition, the scant literature on occupational cultures within industry-research partnerships would not support attempts to define dependent and independent variables. As social activities occurring within organizational and national cultures, commercialisation processes in a complex social system suit holistic investigation using qualitative methods.

A total of twenty scientists, engineers and business managers were recruited from four CRCs. Two of these CRCs were from the Information and Communications Technology sector and two were from the Biomedical sector. The organisations’ maturity ranged from newly formed with only a few years of operation to twenty years of operation for a publicly listed company that developed out of the CRC programme. The participants’ experiences and perceptions of differing subcultural norms, including styles of debate, were recorded and transcribed verbatim. QSR N-Vivo® software was used to aid detailed coding and analysis of the collected research material, facilitating the interpretation process. Member checks, in which the data and interpretations were provided to participants for correction, verification and challenge, were used to increase the credibility of the research.

Through the analytic phase of the project, the research material was found to cluster around a number of core themes. Through a reflective, iterative process, we interrogated theme content to explore relationships between and within the themes.

Despite the suitability of the selected methodology, the research findings depend upon the memory, insightfulness, and honesty of the interviewees. The findings are also constrained by time, place, and the changeable nature of individual perspectives. Consequently, the findings cannot be readily extrapolated to other contexts.

However, as the following section illustrates, the insights provided by the interviewees extends existing theory to consider the potential impact of inter-occupational argumentation on the functioning of hybrid industry-research centres. Therefore, further research into occupational culture, occupational identity, and commercialisation processes in the context of CRCs in Australia is appropriate.

3 Results and Analysis

The interviewees demonstrated clear familiarity with the research topic. They described visible signs of occupational groupings working in commercialisation, the values and beliefs of particular cohorts and perceived boundaries between commercial and research occupational subcultures. Such ability to rapidly grasp and articulate the notion of occupational subculture might be attributed to acumen and education. However, the emotionally charged responses, often marked by frustration, suggest that the impact of different styles of occupational argumentation in commercialisation extends beyond mere intellectual awareness.

An alternate to cultural differences as an explanation for the friction reported between occupational groups is that participants’ experiences were coloured by stereotypes, beliefs that all members of a particular group are similar and think and behave in the same way (Trice, 1993). However, frequent contact between individuals of similar status, cooperating in working towards common goals is demonstrated to reduce stereotyping based on age (Hale, 1998), race (Dixon & Rosenbaum, 2004) and nationality (Stangor et al., 1996). These conditions apply in CRCs. After extensive periods of work contact, in some cases more than twenty years, the CRC members’ reports of occupational difference are based upon observation and engagement, not simple stereotypes.

Argumentation as an Occupational Norm

... we wonder if all of those lovely, extrinsic rewards will cause us to become arrogant, overconfident, or lazy, or -- worst of all -- to stop arguing. We believe the quality of our work will suffer if we stop bickering and are left with only our optimism. (Sutton & Rafaeli, p. 127, in Frost and Stablein (eds), 1992, Doing Exemplary Research.)

Scientists, engineers, and managers from government and private sectors described distinctive patterns of argumentation as typical of different occupations. Descriptions of scientific and research group
debates were consistent with earlier reports (Nemeth, 1997; Ziman, 2000). Restrictions on the amount of time allocated for discussion, the likelihood of reaching a clear conclusion and expectations of action as results of debate were very different for commercial and research communities. Both commercial and academic groups agreed that researchers enjoyed debate and viewed it as an important part of their identity. As stated by a scientist, who moved to a management position;

“The important aspect is inquiry into “What’s the best focus?” It’s not inquiry for the sake of “Let’s muck around.” And that’s often the criticism of science going into commercialisation. Inquiry is a necessary process before you arrive at an agreed way forward. That’s very stimulating and something I really, really miss in shifting from that culture …. difference of opinion is part of the creative process.”

The importance of dissent as a tool to hone solutions through a verbal contest of ideas and as a symbol of scientific identity was evident. When asked if the academic and research members of the CRC enjoyed debating amongst themselves, a public sector manager responded that it was a core part of their professional identity, stating:

“They’ll [researchers] consider [debate] very much part of their reason for existence and if they didn’t have that debate I think they would see themselves as not representing their profession. …. The debate may well air a range of options and different opinions and approaches and thoughts and so forth but it doesn’t crystallize an outcome. And for the private sector all that debate’s good, but if it doesn’t bring you closer to an absolute outcome, an absolute decision, well then all it is is debate. It may be very worthwhile from the academic point of view but time is money when it comes to the private sector.”

Sharing the view that business communication should be action-oriented and produce a clear conclusion a product development engineer remarked:

“There were meetings that only scientists used. They had a university common room meeting culture. They would sit and talk about the latest discoveries in the field; it was just a big chinwag. And that was work. Because they were scientists…they'd talk about the latest things in the field and if it didn't relate to the thing I was trying to make I couldn't care less. I used to get dragged along to them occasionally but, operations point of view, meetings to me were a waste of time. I do the communication I need to do as I need to do it.”

Similar comments were made by other participants, indicating clear understanding and acknowledgement of differences in the acceptability of dissent and the desirability of reaching a clear conclusion in a specified time. Researchers appeared comfortable with, and even proud of their ability to use “talking as thinking” in a mono-cultural group, in contrast to commercial interviewees who preferred talking as preparation for action. Comments regarding time limits for debate suggest that argumentation norms may be influenced by different temporal orientations towards pace and punctuality in the two broad occupational groups. However, consideration of this possibility is beyond the scope of this article.

Research Hierarchies and Argumentation

While researchers focussed upon the role extended argumentation played in knowledge creation, the commercial interviewees stated that argumentation also played a ritual role in expressing and maintaining a hierarchy among research institutions. Managers reported that universities in the “top tier” preferred to deal with others of similar status and did not give as much time to universities perceived to hold low rankings. One manager with an academic background explained:

“This is all about the prestige or precedence of the universities who have a pecking order. To collaborate with someone who is below you in the pecking order is going to pull you down.”

While researchers viewed their debates as impersonal, driven by intellectual challenge and focussed on reaching the best possible solution, several commercial participants commented that extended debates were vehicles to demonstrate and consolidate academic hierarchies and express organisational conflicts within the research community.
Cross-Functional Team Leadership, Participation and Argumentation

In addition to signalling membership of research or commercial subcultures in hybrid industry-research organizations, the use of rational argumentation was identified as a handicap to cross-functional group leadership. Clearly stating all assumptions and relying upon logic to win an argument were viewed as incompatible with the political demands of balancing the needs of multiple public and private stakeholders. As explained by a manager:

“Private sector, their role tends to be very vested interests, hence narrow focus and short and sharp, not bringing in a whole range of otherworldly thoughts into the process but short, sharp and focused. From the government perspective, the government input is more generalized than the private sector, whether it’s going to be useful from a government perspective. Not as focused and as to the point as the private sector but still somewhat focused relative to what the academic debate might be.”

There was general agreement that research debates were closed to non-members, indicating that styles of argumentation may help to create and reinforce occupational boundaries. Tolerance of discussions without time limits and with ambiguous outcomes was identified as an important difference. As a manager commented when asked if rational arguments reached final and lasting conclusions:

“Well sometimes they do. Sometimes they just peter out in the context of “Yes, there’s differing opinion on the subject” and if there’s no categorical resolve well then everyone can go back to their corners agreeing that there’s differing opinions which could be revisited at a later date.”

The norms of scientific argument include a preference for a written format, a well-informed audience, no imposed time limits and little expectation that a “Yes” or “No” conclusion will be reached to support a particular course of action (Ziman, 2000). On the other hand, business decisions have been reported to be frequently based upon preparation that does not conform to the typical pattern of argumentation used in research communities (v. Werder, 1999).

Occupation Specific Argumentation as a Barrier to Commercialisation

In addition to functioning as an occupational identity construct, rational argumentation may contribute to barriers to commercialisation. As a scientist explained:

“The clash occurred where …the mode of working within the culture of science is one that’s driven by inquiry, which is driven by brainstorming. The commercial product managers wanted to focus on one approach only and pin it down, no divergence whatsoever. Even the mode of discussion, conversation, engagement, was so different and the commercial guys found it quite threatening and kept saying “Stop arguing.” … by quelling that inquiry it actually reduced the standards, a mediocrity came into the work, an absolute culture change occurred. That difference of opinion is part of the creative process. But it’s viewed as the dysfunctionality of the [scientific] group, and sort of a threatening aspect. And a couple of times where I’ve sort of gone into “science mode” of really wanting to understand “Why and how” has been seen as threatening. Here as well [referring to new employer].”

A manager from the same CRC offered the following rejoinder when asked about the need for scientists to engage in rational argumentation to identify the best possible solution:

“I generally think that there is a, sensible way forward with a number of options that you can discuss but you should be aware of the options beforehand. And the thing is scientists always say, “You don’t know,” and therefore just stop planning for it, which does drive me nuts. … And that’s not really thinking far enough ahead. And that I’ve seen many, many times, that scientists focus on the next few experiments, and being completely unable to handle uncertainty and complexity which is odd given that’s what they should be doing, and I think that is what business does all the time. If you haven’t told somebody something might go wrong and it does, it might be blindingly obvious to a scientist but if you haven’t told your supporters and investors of the possibility then they are certainly going to see vigorous debate as a failure.”
From the perspective of the researchers, attempts by business people to limit debate were dismissed as “micro-management” and indicative of a desire to “dictate” technical solutions to problems they were not qualified to address. Researchers reported dismay and distrust upon hearing business people publicly announce project timeframes based upon what they viewed as a naively optimistic view; that everything would run to schedule. Both commercial and research informants reported business people viewing rational argumentation as a sign of occupational dysfunction, evidence of inadequate forward planning, or suggestive that the proposed solution will fail.

At least three points emerge from the previous discussion. First, argumentation styles can act as occupational and subcultural norms. Second, the use of distinctive occupational argumentation repertoires may disrupt communication in cross-functional meetings and thirdly, argumentation style may influence perceptions about project statuses and likely outcomes. Undoubtedly, the diverse forms of argumentation favoured by research and commercial occupations provide a sense of group identity and are suited to their differing tasks and organizational environments. However, different argumentation styles may reduce the ability of inter-occupational contributions to commercialisation to be accepted and recognized as constructive.

4 Directions for Future Research and Conclusions

How Can Research and Commercial Groups Talk To Each Other?

Argumentation patterns typical of commercial and research groups represent observable manifestations of divergent occupational values and assumptions. Argumentation norms align with the orientations of commercial and research occupations towards exploitation or exploration activities (March, 1991). In commercial settings action and results are valued, particularly as the focus upon speed as a competitive strategy has increased over the past fifteen years (Vinton, 1992). This leads to argumentation patterns favouring quick decisions oriented towards taking action to achieve short-term organizational goals. On the other hand, commercial argumentation is not easily reconciled with scientific values of accuracy and thorough understanding and can reduce opportunities for recognition and enhanced prestige within specialised research communities. Furthermore, popular management texts praising “strong” business cultures that display consensus and conformity (Pech, 2001) may have exacerbated perceived differences between the two groups’ use of argumentation, contributing to commercial perceptions of scientific argumentation as an occupational and organizational problem.

Research or academic styles of argumentation are characterized by vigorous dissent to create and continuously improve ideas and are not timed while business debates are reported be action oriented, timed and managed to a definite conclusion. In commercial groups, dissent may be perceived as a threat to group cohesion, group hierarchies and the efficient execution of business plans. Members of research groups report enjoying intellectual dissent, consider it to be constructive and value it as a key part of their professional identity. When the groups are separate, they can follow their own norms in parallel. When combined in cross-functional teams, encountering seemingly foreign standards for debate can create frustration and may jeopardize commercialisation outcomes. Members of each community generally regard the debating norms of the other group as unusual and an obstruction to equal participation, (even to the extent of applying labels such as “dysfunctional”) creating barriers to communication and commercialisation. At the same time, members of both groups maintain their occupational subcultural boundaries and identity by continuing their distinct argumentation style in a combined forum, even when doing so impedes communication.

The argumentation rituals used by research and commercial groups may reflect their underlying reward systems and motivation towards producing knowledge or making money. Mutual conflict exists between business pressures for speed and punctuality and research emphasis on thorough understanding to protect and enhance scholarly reputations. However, the different forms and norms of debate and rhetoric fit two key roles in innovation: imagining the as yet non-existent product or service and making it concrete. Scientific or rational argumentation plays a complementary role to business modes of debate through the creation and testing of ideas vital in the early stages of the commercialisation process. Focusing on a specific form of a new product or service, and organizing the team to fund, test and manufacture in volume to meet set deadlines provides the corresponding applied role.
Directions for Future Research

Using an inductive process of theory generation (Eisenhardt, 1989) the argumentation theme arising from the interview data was developed into the following theoretical proposition; The achievement of commercial results in hybrid industry-research organisations can be jeopardised by misunderstandings based upon the styles of debate used by business and research/academic communities. Differences in expectations of time limits and specific outcomes, combined with divergent attitudes towards public dissent, reflect occupational tendencies towards exploration and knowledge production, or exploitation of market opportunities for monetary gain. Members of each community regard the debating norms of the other group as unusual and an obstruction to equal participation, contributing to frustration and barriers to communication and commercialisation.

This theoretical proposition offers many avenues for further research, using qualitative, quantitative or mixed method designs. Future research could consider research and commercial argumentation across national, disciplinary and organisational boundaries and organisational types.

Conclusions

When viewed from the traditional, integrationist perspective of organisational cultural research, hybrid industry-research organisations face the challenge of operating within an organisational cultural paradox; the beliefs, values and assumptions held by groups within the organisation are seemingly contradictory and yet valid. The divergent bodies of knowledge and skills that make the parties attractive to each other, and provide reason to collaborate, simultaneously create obstacles to communication and cooperation. However, recognition of the dominance of the differentiation view of organisational culture in hybrid industry-research organisations may allow managers of innovation to resolve the apparent paradox through acknowledging, respecting and facilitating productive interactions between dissimilar, but ultimately complementary occupational cultures. Clear agreement and enthusiasm for high-level goals can co-exist with fundamental assumptions and values that are in conflict.

If members of hybrid industry-research organizations understand and are aware of the norms and debating rituals of business and research occupational subcultures it may be possible to reduce misunderstandings and support successful commercialisation. To obtain the benefits promised by the formation of hybrid industry-research groups, it is important that each occupational subculture be free to employ its own subculturally appropriate rhetorical forms in single audience meetings. However, a consciousness of differences in styles of debate and modified use of research and business argumentation when inter-occupational subcultures meet, are likely to be advantageous.

Acknowledgement

The researchers would like to thank the participants for their generosity in allowing us to benefit from their time and experience.

References


Appendix 4

Interview Duration in each CRC

The three exploratory interviews occurred between July 23, 2004 and April 1 2005. The single, retrospective interviews with members of the Biomedical Graduate CRC occurred in the twenty weeks between March 7 and July 25, 2005. In the five-week period between April 8 and May 13, 2005, the retrospective interviews with informants from the IT Graduate CRC were completed. Three iterative, longitudinal interviews with each of the informants from the current CRCs occurred as follows: Biomedical Current, in the twelve weeks from September 19 to December 16 2005, and IT Current, in the twenty-nine weeks from May 24 to December 19, 2005.

Table of Trial Interviews

<table>
<thead>
<tr>
<th>Individual</th>
<th>Date</th>
<th>Method of Interview</th>
<th>Interview Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager*</td>
<td>July 23, 2004</td>
<td>Face to face, office</td>
<td>Emic insights from innovation manager who had worked in academic, government and private contexts</td>
</tr>
<tr>
<td>Engineer BiomedGraduate**</td>
<td>Aug 12, 2004</td>
<td>Face to face, home</td>
<td>Emic insights from engineer</td>
</tr>
<tr>
<td>Researcher BiomedGraduate**</td>
<td>April 1, 2005</td>
<td>Face to Face, office</td>
<td>Emic insights from scientist</td>
</tr>
</tbody>
</table>

* This trial interview also appears in the table of interviews outside CRC organisations.

** The trial interviews with the scientist and engineer became the first interviews with members of the BiomedGraduate CRC and so appear the following table.
### Table of Interviews Biomedical Graduate CRC

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<td>Commercial Engineer</td>
<td>Aug 12, 2004</td>
<td>Face to face, home</td>
<td>Emic insights from engineer</td>
</tr>
<tr>
<td>Scientist/Manager</td>
<td>April 1, 2005</td>
<td>Face to Face, office</td>
<td>Emic insights from scientist</td>
</tr>
<tr>
<td>Male Project Scientist</td>
<td>June 10, 2005</td>
<td>Face to Face, office</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td>Female Project Scientist</td>
<td>July 18, 2005</td>
<td>Face to Face, office</td>
<td>Exploration of CRC and research questions, assess gender differences</td>
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<tr>
<td>Financial Manager</td>
<td>July 25, 2005</td>
<td>Face to Face, office</td>
<td>Exploration of CRC and research questions</td>
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### Table of Interviews Biomedical Current CRC

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<td>Sep 19, 2005</td>
<td>Face to Face, office</td>
<td>Exploration of CRC and research questions</td>
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<td></td>
<td>Oct 24, 2005</td>
<td>Face to face, office</td>
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<td>Dec 5, 2005</td>
<td>Face to face, office</td>
<td>Exploration of CRC and research questions</td>
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<tr>
<td>Project Manager (no personnel responsibility)</td>
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<td>Face to face, office</td>
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<td>Nov 14, 2005</td>
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<td>Dec 9, 2005</td>
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<td>16 Dec, 2005</td>
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**Table of Interviews IT Graduate CRC**

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<td>CEO</td>
<td>April 8, 2005</td>
<td>Face to face at home</td>
<td>Exploration of CRC and research questions, high DRSO rate</td>
</tr>
<tr>
<td>Communications Manager</td>
<td>April 8, 2005</td>
<td>Face to face at home</td>
<td>Exploration of CRC and research questions, role of communications managers in CRCs</td>
</tr>
<tr>
<td>Scientist</td>
<td>May 13, 2005</td>
<td>Face to face at office</td>
<td>Exploration of CRC and research questions</td>
</tr>
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</table>

**Table of Interviews IT Current CRC**

<table>
<thead>
<tr>
<th>Individual</th>
<th>Date</th>
<th>Method of Interview</th>
<th>Interview Purpose</th>
</tr>
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<tbody>
<tr>
<td>CEO</td>
<td>May 24, 2005</td>
<td>Face to Face, office</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td></td>
<td>July 29, 2005</td>
<td>Phone</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td>Individual</td>
<td>Date</td>
<td>Method of Interview</td>
<td>Interview Purpose</td>
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<tr>
<td>------------------------</td>
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<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Manager/Business</td>
<td>May 24, 2005</td>
<td>Face to Face, office</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td>Manager/Government</td>
<td>July 1, 2005</td>
<td>Phone</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td>Manager/Private Co.</td>
<td>Aug 29, 2005</td>
<td>Phone</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td>Oct 4, 2005</td>
<td>Oct 4, 2005</td>
<td>Phone</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td>Dec 13, 2005</td>
<td>Dec 13, 2005</td>
<td>Phone</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>June 27, 2005</td>
<td>Face to face office</td>
<td>Exploration of CRC and research questions</td>
</tr>
<tr>
<td>Researcher/University</td>
<td>Aug 30, 2005</td>
<td>Face to face office</td>
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</tr>
<tr>
<td>Individual</td>
<td>Date</td>
<td>Method of Interview</td>
<td>Interview Purpose</td>
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<tr>
<td>------------</td>
<td>------------</td>
<td>---------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Oct 11, 2005</td>
<td>Face to face office</td>
<td>Exploration of CRC and research questions</td>
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<tr>
<td></td>
<td>Dec 19, 2005</td>
<td>Face to face office</td>
<td>Exploration of CRC and research questions</td>
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### Table of Interviews Outside CRC Organisations

<table>
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<th>Individual</th>
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<th>Method of Interview</th>
<th>Interview Purpose</th>
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</thead>
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<tr>
<td>CEO</td>
<td>Sep 9, 2005</td>
<td>Phone</td>
<td>Discussion of very new CRC</td>
</tr>
<tr>
<td>Academic</td>
<td>Aug 3, 04</td>
<td>Face to face office</td>
<td>Insights from academic working in cross national culture innovation field</td>
</tr>
<tr>
<td>Manager</td>
<td>July 23, 2004</td>
<td>Face to face, office</td>
<td>Emic insights from innovation manager who had worked in academic, government and private contexts</td>
</tr>
</tbody>
</table>

In summary, thirty-six interviews occurred with twenty individuals, eighteen male and two female.
Appendix 5

Commonwealth of Australia Agreement to Create a CRC

The full contract can be viewed at:

The text below is extracted to illustrate the areas covered in the contract.

TABLE OF CLAUSES

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<td>SAFE AND ETHICAL RESEARCH</td>
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<td>ENTIRE AGREEMENT AND VARIATION</td>
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Appendix 6

Results Working Paper provided to Research Participants

“Inter-occupational Innovation: an Investigation into Interactions between Commercial and Research Occupational Cultures.”
A Summary of Preliminary Results from PhD Research.

Kate Hayes
katehayes@optushome.com.au

Working Paper No. 00-100

CInIS Centre for Industry and Innovation Studies Research Centre,
College of Business,
University of Western Sydney,
Locked Bag 1797,
Penrith South DC NSW 1797

ISBN 1 74108 1378
Executive Summary of Results

The objectives of this paper are to provide a summary of results to people interviewed as part of the study of interactions between commercial and research occupational cultures in commercialisation, and invite comment via e-mail.

Occupational subcultures were unanimously agreed to exist in the organisations studied and appear to be broadly based upon membership of research or commercial occupations. The key boundary markers emerging from analysis and comparisons of the interviews are not visible, but are based upon the beliefs, values and assumptions held by the two communities. Motivation, styles of debate (including the acceptability of dissent), views of time and timed events and perceptions of power and status between research and commercial occupations were clearly identifiable barriers between the “two tribes” and were viewed as hindering commercialisation. This summary is not a complete list of cultural symbols, beliefs and assumptions that characterise and delineate the two groups.

<table>
<thead>
<tr>
<th>Subcultural Boundaries</th>
<th>Commercial Beliefs</th>
<th>Research Beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debate</td>
<td>Extensive public dissent inefficient and divisive.</td>
<td>Extensive public dissent essential and constructive.</td>
</tr>
<tr>
<td>Power/Status Perceptions</td>
<td>Clearly in control in funding, less control over personnel than usual.</td>
<td>Resentful, perceptions of reduced status and autonomy.</td>
</tr>
</tbody>
</table>

Source: Analysis of 36 interviews with individuals working in commercialisation.

The boundary between the occupational subcultures is strong, and appears to be permeable in one direction only as people have moved from research to commercial, but not from commercial to research positions. Infrequent migration from business to research positions is in part due to the stringent criteria for inclusion in research communities, and in part because the commercial members interviewed expressed little desire for, or interest in becoming researchers.

Attempts to produce a single, strong, integrated organisational culture are likely to be ineffective and even counter-productive given the need for complementary business and research skills and their associated subcultures in commercialisation. The strength of researcher culture, and perceptions of the necessity of its norms for effective and efficient knowledge creation, suggest management efforts to make “them” more like “us” will fail. A constructive form of symbiosis is likely to be the best organisational outcome for temporary alliances of members of research and commercial occupational subcultures. Expectations of synergy, (a combined effect greater than the sum of the individual forces) while politically and economically attractive, are unlikely to be met, with regrettable assessments of failure applied to both groups.
Preliminary Research Results

Objective

This paper’s objective is to provide a summary of results to the people interviewed in the study of interactions between commercial and research occupational cultures in commercialisation. The summary of the key preliminary findings, while in no way conveying the range of ideas discussed in the interviews, offers participants an opportunity to quickly review the results and respond via e-mail.

The key findings are described without making express reference to theoretical or methodological literature to reduce the size and increase the readability of the document. For the same reasons, many interesting but disputed findings have not been included in this summary. Complexities and contradictions abound in the organisational context of hybrid research centres, due in part to their temporary nature and the challenges of “co-opetition” between member organisations. The paper does not address the structural issues associated with hybrid research organisations, as the focus of the thesis is occupational subcultures in commercialisation. However, these issues present a potential topic for future work.

Participants are invited to comment on the results and register an interest in receiving a summary of conclusions when the thesis is complete. The purpose of the summary of conclusions will be to assist people crossing the boundaries between research and commercial communities in their work.

Organisational aspects of commercialisation have been extensively studied through structural foci, such as the size, funding and age of the organisation, using both qualitative and quantitative methods. Recent work, although not intending to consider the impact of culture upon commercialisation, suggests the norms and values of occupational subcultures may affect commercialisation processes and outcomes. The current study investigates the potential existence, and impact, of occupational subcultures upon the commercialisation phase of innovation. The research questions concern if and how occupational subcultures affect commercialisation processes and if the formation of occupational subcultures has managerial implications for organisational goal achievement.
Methodology

The organisations studied consist of individuals from a variety of professions aligned with a particular industry, located within a broad context of Australian society and public research policy decisions. The ability to effectively identify, isolate, and accurately measure both dependent and independent variables within a natural setting is limited. Also, the scant literature on occupational cultures within industry-academic research partnerships would not support attempts to define dependent and independent variables. As social activities occurring within organizational and national cultures, commercialization processes in a complex social system suit holistic investigation using qualitative methods.

Four temporary, hybrid organisations composed of research and commercial personnel engaged in commercialisation activities were recruited and individuals from managerial, research and engineering roles were interviewed. Thirty-six semi-structured interviews were conducted with twenty individuals. Two organisations were aligned with the Biomedical field and two with the Information Technology and Communications sector. The organisations’ maturity ranged from newly formed (two years) to publicly listed companies (more than fourteen years). The interviewees’ experiences and perceptions of differing subcultural norms were recorded and transcribed verbatim. QSR N-Vivo® software was used to aid detailed coding and analysis of the collected research material, facilitating the interpretation process.

The research findings, as is the case with all qualitative work, are constrained by time, place, and the changeable nature of individual perspectives. Consequently, the findings cannot be readily extrapolated into other contexts. However, the insights provided by the interviewees have potential to extend existing theory to consider the impact of occupational subcultures on the performance of hybrid research centres.

Through the analytic phase of the project, the research material was found to cluster around a number of core themes. At least four main areas of subcultural difference arise from interview analyses, combined with reflection on the themes and patterns
revealed by comparisons between individuals and organisations. The major themes relate to motivation, styles of debate including the acceptability of dissent, views of time and timed events and perceptions of power and status between research and commercial occupations.

**Existence of Occupational Subcultures**

*Are occupational subcultures evident in the commercialisation stages of the innovation process, and if so, what distinctive cultural forms identify them?*

The interviewees demonstrated clear familiarity with the research topic. They described visible signs of occupational groupings working in commercialization; the values and beliefs of particular cohorts; and perceived boundaries between commercial and research occupational subcultures. Such ability to rapidly grasp and articulate the notion of occupational subculture might be attributed to acumen and education. However, the emotionally charged responses from members of both research and commercial groups, often expressing frustration, suggest that the impact of different occupational subcultures in commercialization extends beyond mere intellectual awareness.

Agreement that occupational subcultures existed and at times affected commercialisation outcomes was unanimous. The only difference of opinion related to the extent of the separation between the occupational subcultures. Several informants described “two tribes” (research and commercial) or “three tribes” (researchers/engineers/managers, or commercial/government/research) co-existing in the same world. However, for some interviewees the boundaries between the groups were viewed as impermeable, leading to interpretations of two separate and distinct worlds.

This finding was not affected by the age of the organisation or its sector affiliation.
Manifestations of Occupational Sub-cultures in Hybrid Research Organisations

**VISIBLE**

Among the visible signs of subculture reported and observed, are physical separation, (different buildings, separate meetings and separate reporting structures), clothing style (eg. white lab coats used to convey scientific credibility, commercial people maintaining business suits), form of address (maintaining the use of, or declining to use honorific titles such as doctor and professor), rituals in which only one group participates (e.g. academic-style debates) and rites spanning months which, in addition to performing a technical function, coincidentally manage the process of combining the contributions of research and commercial groups and negotiating compromises between their differing motivations.

**INVISIBLE**

Underpinning visible symbols and behaviours are sets of values and assumptions that seem to offer the basis for classification of two broad research and commercial occupational groupings. Each of these is worthy of expanded treatment, but consistent with the objective of the working paper, will be summarised here.

**Motivation**

Distinctive assumptions about what is the “right” or “natural” objective to pursue seem to be held by the members of research and commercial communities interviewed. Researchers viewed themselves, and were viewed by others, as being primarily motivated by the opportunity to explore, discover and create knowledge. Rewards received were in the form of recognition of their peers and enhanced prestige within their specialised, often academic, communities. Commercially oriented engineers and managers, by contrast, reported that their motivation was a return on the investment of their time, effort or money. This was translated into behaviours that focused upon opportunities that offered the highest probability of a monetary return, followed by creating and executing least risk plans to achieve that monetary return in the shortest possible time.
In short, a motivation towards knowledge creation was translated into approaches to commercialisation activities that favoured exploration until all knowledge viewed as prerequisite for a thorough understanding had been obtained. Motivations towards moneymaking led to a strong focus on time to market, planning and the elimination of risk rather than the pursuit of complete understanding.

**Argumentation**

Consistent with the occupational approaches of explore/create knowledge and focus/plan/produce money, differences existed in the ways in which the two groups used debate, within and between their communities. Distinctive patterns of argumentation (the action or process of reasoning systematically in support of an idea) were identified as typical of commercial and research occupations. Restrictions on the amount of time allocated for discussion and expectations of action as the result of debate were markedly different for commercial and research communities. Both commercial and academic groups agreed that researchers enjoyed debate and viewed it as an important part of their identity. The importance of dissent as a tool to hone solutions through a verbal contest of ideas and as a symbol of scientific identity was evident.

In contrast, the commercial view was summarised by a number of respondents as “time is money” and emphasis was placed upon the view that communication should be action-oriented and produce a clear conclusion. Some of the interviewees managing research groups clearly understood that engaging in scientific argumentation could alarm industrial members by raising spectres of destructive dissent or delay. The interviewees revealed that occupational membership, not organizational affiliation, was the source of differing norms of argumentation. Consequently, the style of argumentation employed by members of research or commercial occupations does more than identify group membership. It can impede communication across occupational subcultural boundaries.

**Time**

Assumptions and beliefs about time seem to strengthen the boundary between commercial and research groups working in commercialisation. Three components are apparent. The first deals with planning time frames with broad agreement amongst interviewees that businesses, and in particular, small and medium enterprises (SMEs) hold a short-term view while researchers apply a longer-term perspective to their
activities. Secondly, the respondents generally agreed that members of commercial
groups would focus on one major activity and move sequentially between activities as
they were completed. In contrast, researchers reported keeping a number of projects
active at a time. Non-researchers held the same view; that researchers engaged in several
projects concurrently. One interviewee strongly disputed this view, claiming the
preference to work in a monochronic (sequential) or polychronic (overlapping) style to
be an individual rather than an occupational characteristic.

The two contrasting motivations, and the associated assumptions about the rightness and
worthiness of pursuing money or knowledge, underlie the difference in attitudes reported
by research and commercial members towards the temporal dimensions of pace and
flexibility. Pace includes attitudes to waiting and queues, what constitutes an efficient
use of time and patience or impatience about perceived delays. Flexibility incorporates
punctuality, distinctions between “clock time” and “event time” and the blurring of work
and social time. In general, the industry members of the organisations viewed meeting
project deadlines and working quickly to get a product to market as being of the utmost
importance.

Conversely, members of research groups expressed a more relaxed attitude to schedules
and deadlines. Whilst supporting the use of project plans and schedules, and saying they
did their best to meet deadlines, the non-routine nature of discovery work, combined
with the perceived importance of making findings of major significance and developing
a full understanding were viewed as unavoidable sources of delay. Members of both
groups reported that, at times, commercial managers would attempt to manipulate the
tempo of work through project schedules in an attempt to control activity. Several
researchers perceived this as unproductive and, from their perspective, somewhat
unethical. (Conversely, attributions of research institutions attempting to place inflated
monetary values on “know-how”, shared equipment or double-bill their time were cited
as unethical by business respondents). The different attitudes regarding pace and
flexibility may, upon further analysis, support characterisation of a commercial “hunter”
view of time (careful preparation to capture an opportunity that may appear once,
culminating in highly visible success or failure) and a research “gatherer” view (cyclical
activity, blurred boundaries between tasks that build a body of work, in which failure can
be instructive, is often invisible and may ultimately be the source of later success).
Links between Motivation and Time

Individuals in both commercial and research groups used Benjamin Franklin’s aphorism “Time is money” during interviews. So how are different views of time explained? If time and money are viewed as being of equal importance, and a high value is placed on money, then time will also be viewed as precious. However, a potential explanation is found in the consensus of informants that the rewards of research do not come *primarily* in monetary form. To enlist another aphorism, “Money isn’t everything”.

The lower priority placed upon monetary rewards by researchers is consistent with previous works regarding the reward systems of scientific communities. However, the research community is not immune to or unaware of the issues of power and status associated with access to research grants and funding available through the hybrid organisations.

Knowledge is not Power outside Research Institutions

While members of the research community may not necessarily be expecting large monetary rewards for their involvement in the hybrid industry/research centre, several interviewees mentioned notions of their contribution being undervalued. Two went so far as to volunteer a description of their role as one of intellectual slavery. An evident theme involved research institutions acting as sub-contractors (rather than consultants) to commercial enterprises which then bore the business-related risks of the projects. Power was agreed to rest in the hands of the industrial partners. The industrial partners were clearly aware that governmental desires for a return on research investment and an increasing dependence of research institutions upon industrial research spending gave them power in the relationship. Some were uncomfortable managing researchers on secondment from academic institutions, with no direct employment contract to provide control over their security of employment.

Characteristics of Boundaries between Research and Commercial Occupational Subcultures

*What can be determined about boundaries between subcultures in terms of shape, thickness and permeability in the context of commercialisation practices and outcomes?*
While there are strong boundaries between research and commercial communities, several interviewees had moved from research to management positions. Some specialised research groups were viewed as closed communities. These boundary-crossers provide a potential human link between the two occupational subcultures.

No interviewees in research roles had moved from a commercial position. Comments were made to the effect that it was not sensible or desirable to do so.

**Perceptions of the Impact of Occupational Subcultures upon Commercialisation.**

*How do CRC members perceive that occupational subcultures impact upon their work?*

Interviewees had clear intellectual understandings of the potential benefits of collaboration and the necessity of using complementary research and commercial skill sets in commercialisation activities. However such benefits appeared distant when dealing with the day to day frustrations that seem to stem from the “other” group’s apparent inability to understand or follow the norms, (socially enforced, unwritten rules that express value systems, including how things ought to be, or how things should be done) self-evident to each community.

The perceived impact of occupational subcultures is negative. The level of difficulty encountered varied from consciousness of tension between motivations and approaches to tasks, to complete breakdown of communication. It is noteworthy that in one organisation similar issues were reported to occur within the boundaries of the research community.

Some examples of barriers to successful commercialisation illustrating the impact of disparate subcultures include:

Insistence upon, or intolerance of dissent in shared meetings.

Engaging in “satisficing” in decision making, (i.e. settling for the first option that can work for the situation, rather than an optimal solution) particularly when trying to balance individual stakeholder needs (research, industry, government) with organisational goals.
Protracted negotiations over ownership of IP and the financial value that should be allocated to “know-how” and continuing disputes regarding “fair” recognition of contributions made.
Different expectations about the frequency and depth of communication required of collaborating partners.
Perceptions that one group is benefiting at the expense of the other.
Opposing priorities that stem from different motivations, including the desirability of adding features vs. reducing manufacturing costs and the wisdom of delivering products on time with reduced function vs. late with enhanced function.

Managing the Impact of Occupational Subcultures

How can occupational identities and boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?

Members of research and commercial groups in working together in commercialisation will almost inevitably experience tension and resist accepting each others group norms. The issues associated with function vs. cost and the timing of market entry certainly seem to represent eternal challenges. The organisational imperative appears to be to ensure constructive, not destructive conflict results from the expression of occupational differences. Commercialisation is, by definition, a multidisciplinary activity, involving development, design and testing, after the initial discovery. It also involves specialised knowledge of financial markets, distribution, and marketing. Different skills and mindsets are required to prove the potential feasibility of a product or service and bring it to market launch. The interviewees’ identification of separate subcultures, separate conventions, forms of address and dress, and differing beliefs, does not necessarily augur badly for productive commercialisation. Several informants commented on the potential for synergy.

However, the patterns of interaction and the perceptions reported by participants describe experiences closer to symbiosis rather than synergy. In biological terms, symbiotic relationships run the gamut from competition and parasitism through commensalism (in which one member of the association benefits while the other is not affected) to mutualism, in which the association is beneficial to both parties. The
managerial question appears to be how to bring about a constructive form of symbiosis and to avoid damage to individuals and member organisations.

Two strategies to lessen the impact of occupational subcultures were described by the organisations represented in the research. One involved the use of boundary-crossers. These key individuals, skilled and often certified (holding educational and professional qualifications) in two distinct bodies of knowledge, translated the behaviour, knowledge-systems and social values of one group for the other. The second strategy was process based, using formal procedures to track the development of ideas, manage what is included and what is left out of prototypes and then move control from research to design engineering personnel, on to production engineering and finally to business management.

Attempts to produce a single, strong, integrated organisational culture are likely to be ineffective and even counter-productive given the need for complementary business and research skills and subcultures in commercialisation. The strength of researcher culture, and perceptions of the necessity of its norms for effective and efficient knowledge creation, suggest management efforts to make “them” more like “us” will fail. A constructive form of symbiosis is likely to be the best organisational outcome for temporary alliances of members of research and commercial occupational subcultures. The improved outcomes associated with inter-disciplinary or cross-functional teams may not necessarily be replicated in inter-occupational and inter-organisational collaborations, where there is a greater distance between cultural assumptions, values and norms. Expectations of synergy, (interaction of two or more agents so that their combined effect is greater than the sum of the individual forces) while politically and economically attractive, are unlikely to be met, with regrettable assessments of failure applied to both groups.

The next stage in the research is to consider the implications of the findings in relation to management theory and existing literature. A summary of preliminary conclusions and recommendations will be available by the end of 2006 to assist people working with research and commercial communities in commercialisation.
Appendix 7

Participant Consent and Information Sheets

An Investigation into Patterns of Interaction in Moving New Products from Laboratory to Market.

Principal Researcher: Kate Hayes B.Sc., MBA, Doctoral Student, School of Management, University of Western Sydney. Tel: 0416 304 447

Supervisor: Dr. Anneke Fitzgerald, Lecturer, Organisational Studies, School of Management, College of Law & Business, University of Western Sydney Tel: (02) 4620 3414

Dear Participant,

I am a doctoral research student from the University of Western Sydney. The objective of my study is to develop a better understanding of the interactions between people in different occupational roles in the process of preparing a new technology for commercial sale. Examples of the types of occupations that may be of interest are Scientists, Lawyers, Engineers, Managers, Human Resources and Communication personnel.

I am very interested in your thoughts on this matter and would like an opportunity to interview you. Participation in this study is entirely voluntary and you may withdraw from the study at any time. Participation will involve being interviewed about your experiences and perceptions concerning commercialization processes. With your permission interviews will be recorded.

This study involves no known or anticipated risks. All information you provide will be considered confidential and will be used for research purposes only. Your name will not be linked to the interview content. Audio recordings will be reviewed only by members of the research team. Your name will not appear in any report, publication or presentation resulting from this study. All data will be kept secure in a locked cabinet at the University of Western Sydney for a period of 5 years after the study is completed before it is destroyed.
Consent Letter

I, [insert participant’s name], have read and understand the information attached and agree to participate in this study being conducted by Kate Hayes of the University of Western Sydney’s School of Management. Any questions I have asked have been answered to my satisfaction. I understand that my participation is entirely voluntary and that I can withdraw at any time.

As a participant in this study I realize that I will be asked to respond to interview questions. All information that I provide will be held in confidence and I will not be identified in any way in the final report. I also understand that this project has been reviewed and received ethics clearance through the Human Research Ethics Committee at the University of Western Sydney and that I may contact this office if I have any concerns or questions about my involvement in this study.

Participant’s Name (please print) ...........................................................
Participant’s Signature: ..............................................................
Name of Witness (please print) ....................................................... 
Signature of Witness: .................................................................
Date: .......................................................................................

NOTE: This study has been approved by the University of Western Sydney Human Research Ethics Committee. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Research Ethics Officers (Tel: 02 4570 1136). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Appendix 8

Research Protocol, as at March 28, 2005

Inter-occupational Innovation: an Investigation into Interactions between Commercial and Scientific Occupational Cultures

Thesis Statement

‘Human life is reduced to real suffering, to hell, only when two ages, two cultures and religions overlap.’ (Hesse, 1963)

While not producing conditions that truly deserve to be called “hellish”, strong occupational cultures, working closely together under perceived pressure to perform may create obstacles to success. Differences in communication styles, jargon, mental models, temporal orientation and profit-making ideologies may have the potential to accelerate, hinder or even prevent successful commercialisation.

This research focuses upon interactions between commercial and scientific occupational groups preparing inventions for market launch. The Australian Cooperative Research Centre (CRC) Program provides the organisational context. The processes of commercialising a new idea or product provide the opportunity to examine intense, extended interactions between commercial and scientific occupations.

Thesis Problem

The thesis problem that occupational subcultures exist within CRCs and impact commercialisation outcomes will be investigated through the following research questions:
Research Questions

1. To investigate the potential existence of occupational subcultures in CRCs it is necessary to examine:
   
   1a. What patterns of intra and inter-occupational interaction appear in the commercialisation stages of the innovation process?
   
   1b. What distinctive cultural forms, if any, characterise occupational subcultures engaged in commercialisation?

2. What can be determined about boundaries between subcultures in terms of shape, thickness and permeability in the context of commercialisation practices and outcomes?

3. How do CRC members perceive that occupational subcultures impact upon their work?

4. How can occupational identities and boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?

These research questions will address the role played by inter-occupational interaction in the commercialisation stage of innovation.

Through identifying patterns of interaction, this research will investigate the existence and extent of occupational identity constructs. Behavioural patterns and occupation-specific cultural forms will be considered in order to determine the dimensions that may form the basis for subculture formation and maintenance in CRCs. Previous employment, educational histories, and the relative occupational rewards for successful commercialisation will be considered as potential boundary constructs.

An interview protocol helps to ensure consistency across cases in multiple case research designs (Yin, 1994). The emic insights gained from the three exploratory interviews were used to develop potential questions operationalising each of the research questions. The potential interview questions concerned the existence of occupational subcultures, observed cultural forms, occupational subcultural boundaries, the impact of any subcultural boundaries and ways of managing them to improve commercialisation processes and outcomes. The development and use of an interview protocol ensured that
the findings of the exploratory interviews were captured and used in a systematic way between cases, between participants and over time.

**Research Questions Linked to Interview Questions (data collection)**

(Interview questions extracted from sample questions submitted with thesis proposal, with some recent additions. Questions judged to be most likely to illuminate research questions are preceded by two asterisks.)

1. **Sub-Cultural Forms and Patterns of Interaction**

   *To investigate the potential existence of occupational subcultures in CRCs it is necessary to examine:*

   1a. What *patterns of intra and inter-occupational interaction appear in the commercialisation stages of the innovation process?*

   ** 1. Would you please describe the way you work with other groups to get a product ready for market? (For example, do you work in teams comprised of a range of occupations?)
      What do you do?
      Which group takes the lead?
      In your opinion, why?
      Who has responsibility for the overall process?

   **2. How does communication take place?**
      Can you describe any examples?
      Whom do you communicate with most face to face, including meetings, in the course of your work?
      What are the reasons for this?
      Whom do you communicate with most in writing, including e-mail?
      What, in your opinion, are the reasons for this?
      What other occupations do you work with in the process of getting a product ready to be sold?
      Whom do you spend most of your working time with?
How did this come about?
Is this how you prefer to work?

1b. What distinctive cultural forms, if any, characterise occupational subcultures engaged in commercialisation?

** 1. Please tell me key words you would use to describe the culture of (name of group informant belongs to) in this CRC. (provide example of culture if respondent unsure of meaning, e.g. Australia has a national culture, and has groups within it that show some differences e.g. people in Canberra compared to people in Darwin).
Could you tell me a little about each word and how it describes the (insert name) group?
Do you think this culture is different to that of the total organisation?
How is it different? (If you want to uses examples to show differences that would be fine.)

** 2. What are the main differences you see between professional groups working in CRCs?
How are these differences expressed? Examples?
How can you tell if someone is a manger, scientist or engineer? (probe for cultural forms, display/dress, jargon, rituals, norms and content themes)
Your job title is_________, how would you describe the guiding principles, or values that direct your work?
Can you please give some examples?
Can you tell me one descriptive word (or metaphor) you’d use to describe working in this CRC?
Why do you describe it this way?

2. Boundary characteristics
What can be determined about boundaries between subcultures in terms of shape, thickness and permeability in the context of commercialisation practices and outcomes?

**1. Are there any activities only performed by you or people with the same occupation?
Can you please give some examples?

** Do different occupational groups in your organisation judge events the same way?
can you please give some examples?

** How would you describe the relationships between scientists, managers and
engineers?

**2. Which group do you think is most powerful in your organisation at this time?
Would you give an example to explain why it appears powerful?
Has this group always been dominant?
How is this power expressed?

** Do you expect this group to continue to be the most powerful?
How does this group’s power impact relations between groups working to
commercialise new products?

** Do you think organisational politics in the CRC are different from those you have
experienced in other organisations?
Why or why not?
Can you please give examples of events that show this?

** 5. Do you think you have changed the way you think of your job, or approach your
work tasks since joining the CRC?
Thinking about the way you work, which professional occupation would you say
is most similar to yours?
Would you please describe some of the ways it is similar?
Thinking about the way you work which professional occupation do you think is
least similar?
Would you please describe some of the ways it is different?

3. ** Perceptions of subcultural impact

How do CRC members perceive that occupational subcultures impact upon their work?

1. ** In your view, how should the commercialisation process work? (probe for linear
or iterative commercialisation processes)
Is this how the commercialisation process works in this CRC?
Can you please give any examples?
Are you happy with that?

** Are there any positive or negative commercialisation results of one occupational
group being powerful?
Can you describe any examples?
And, in your opinion, what is the result of successful commercialisation?
Can you describe any examples?

2. Can you describe any examples of unsuccessful commercialisation?
What happens if someone sees something they consider to be a threat to success?
Can you give an example of what has happened?

3. Is there a group, or groups that perhaps you find it easy to work with?
What makes them easy to work with?
Can you give an example of a recent event that illustrates this?

4. Is there a group, or groups that you find it difficult to work with?
What makes them hard to work with?
Can you give an example of a recent event that illustrates this?

4. Influence of occupational subcultures and boundaries upon organisational function

How can occupational identities and boundaries be managed to improve organisational processes and outcomes in Australian Cooperative Research Centres?

** 1. Can you tell me one descriptive word (or metaphor) you’d use to describe this CRC?

** 2. In your opinion, do different occupations work well as a CRC team?
Would you please give an example of when you’ve observed this?
Why did it work?
If they don’t view themselves as a team, what are the relations between the groups?

** 3. Would you please give examples of when relationships have been improved or got worse?
Do you believe engineers, managers and scientists view themselves as part of the same team? Why?

** 4. Do the occupations or the larger team ever discuss inter-occupational issues?
Does any action result from these discussions?
To what degree are employees encouraged to discuss conflicts and criticisms openly?
How would you describe their relationship with you?
In your view, could any of these relationships be improved?
How?

5. Other Interview Questions (may be useful as introductory ice-breakers)

What would you want to achieve professionally from working in this CRC?
What would you like to achieve personally from working in this CRC?

1. Would you tell me a little about your employment before you joined this CRC? (how many years? what org? which country?).

2. How did you organise your work in these places? (for example did you work alone? As part of a group all doing the same sort of work? As part of a multi-disciplinary team?)

3. How did you come to join the CRC?

4. What training, or information about how to work in the CRC, did you receive when you joined?
What (or who) do you see as the greatest impediment to success?

**Sample Questions for non Eng/Mgmt/Scientific Staff**

1. In your opinion, do scientists, engineering and managers work well as a team?

2. Would you please give an example of when you’ve observed this?

3. What are the main differences you see between professional groups working in CRCs?

4. How are these differences expressed? Examples?
5. How would you describe the relationship between scientists and engineers? 
   Can you give an example of an event that shows this?

6. How would you describe the relationship between scientists and managers? 
   Can you give an example of an event that shows this?

7. How would you describe the relationship between engineers and managers? 
   Can you give an example of an event that shows this?

8. In your view, could any of these relationships be improved? 
   How?

9. Would you please give examples of when relationships have been improved or got worse?

10. Do you believe engineers, managers and scientists view themselves as part of the same team?

11. To what degree are employees encouraged to discuss conflicts and criticisms openly?
Appendix 9

Recruitment, Purposive Sampling and Interview Tone

This section describes the recruitment process and rationale for the individuals involved in exploratory interviews and the organisations and individuals in each of the four CRCs.

Due to the exploratory nature of the work, the intensive nature of interviewing, and the small groups of people working in CRCs it was not desirable or possible to use the probability sampling strategies advocated for large survey studies (D. R. Cooper & Schindler, 1998). Purposive sampling, (sampling with the intent of the study in mind) was accomplished through an emergent sampling design, including continuous focusing of the sample and selection to the point of redundancy (Lincoln & Guba, 1985). Efforts to establish consistency in terms of interview format and procedures were explicitly included in the design of the research. Specifically, the interview protocol was reviewed before each interview and CRCs were recruited from only two industry sectors: Biomedical and Information Technology and Communication.

Sources of Information

The CRC program currently funds seventy organisations. The information and communications technology and medical science categories both have nine CRCs (CRC Association, 2006). Two CRCs or twelve percent of each of the information and communications technology and medical science CRCs participated. A total of thirty-six interviews occurred across twenty individuals, eighteen male and two female. The two CRCs currently in receipt of funding were of similar size and had between 40 and 50 full time equivalent members. Approximately 13 % of the IT Current and 7 % of the Biomedical Current members were interviewed, (not counting members with less than a 100% commitment in the calculation). It is difficult to provide any estimates for the IT Graduate and Biomedical Graduate organisations as their participation in the program had ended. In addition, the sizes of the two Graduate organisations fluctuated over time as sub-groups developed a technology and were then spun off as independent businesses.
The final number of informants was influenced by assessments of theme clarity and whether new information was being collected. The sampling choices reflect thought processes and decisions that changed once interviewing started based on theoretical sampling decisions but care was taken to ensure equal coverage.

**Recruitment of Organisations**

The four organisations recruited to the study are identified by the pseudonyms IT Current, Biomedical Current, IT Graduate and Biomedical Graduate. Direct approaches to the executive managers of existing CRCs or CRC spin-offs, the Australian Department of Education, Science and Technology and the Australian CRC Association produced three lists:

- CRCs in formation (funding announced in 2004)
- Currently funded CRCs and
- Companies created from CRCs, known as Direct Research Spin-Offs, (DRSOs).

CRCs involved in the commercialisation of a for profit product were targeted for recruitment in preference to environmental or “public good” CRCs in the expectation that they would have a strong commercial orientation among the CRC management.

An e-mail was sent to the executive management contact from the CRCs in formation list, and then followed up with a phone call. The invitation to participate in the research is contained in appendix 11. The same invitation was printed on University of Western Sydney letterhead and mailed to the executive manager of the CRC organisations on the currently funded list. More than four organisations fitting the industry criterion responded to the direct mail letter. In exchange for their participation, organisations were offered a summary of the research results and recommendations. This was provided in the form of a working paper, see Appendix 6.

Ideally, the four organisations involved in the study would have been located in the Sydney metropolitan area due to budgetary constraints upon the research. However, one organisation, IT Current had remote members spread across cities, regional centres and states. A flight to meet and interview two key managers face to face occurred. The other remote interviews were conducted by phone. The potential impact of using phone only
interviewing for some informants was overcome by spending more time building rapport, eliciting questions about the research, and checking the accuracy of my understanding of the interview. The data acquired by ‘phone was equally rich and the interviews were similar in length, tone and conversational content to those conducted face to face.

One interview was held with a manager in a CRC in too early a stage a development to permit its participation. Another Biomedical CRC that had responded to the direct mail request for participants acted as a replacement. The length of time since first receiving CRC funding were; IT Current, two years, Biomedical Current, nine years, and over fourteen years for both IT Graduate and Biomedical Graduate CRCs. Consequently, the sample provided a good range of organisational maturity.

**Recruitment of Individuals**

Purposive sampling decisions drove the recruitment of all interviewees. Description of the sampling strategy follows.

**Individuals Recruited for Trial Interviews**

*Exploratory Interviews and Question Design*

Recommendations for “best practice” cross-cultural research (Schaffer & Riordan, 2003) can be applied to the development of questions for qualitative studies. Question design used a combined emic-etic (insider-outsider) approach. Exploratory interviews concerning the experience and perception of interactions between researchers and business personnel in commercialisation took place with a scientist, a manager and an engineer. This accommodates potential differences in occupational groups. It may be possible to ask some questions of all groups, but other questions may be meaningful for only one or two occupations. Questions about communication, teamwork and commercialisation in the context of specific organisational and occupational cultures were developed and reviewed by a panel of experienced supervisors and included in the research protocol, contained in Appendix 8.

The first individual recruited to provide emic insights into the occupational subcultures of interest was an experienced manager who had worked in commercial, governmental
and academic commercialisation settings. The second was an eminent scientist working in a publicly listed company. The third individual was an engineer. The scientist and engineer both had worked in the same Direct Research Spin Off (DRSO) from a CRC. Their interviews were the first in the Biomedical Graduate CRC organisation.

Recruitment of individuals differed between current and graduate CRC organisations. The next two sections explain these differences.

### Individuals Recruited within the Four CRC Organisations

#### Recruitment of individuals from CRCs Currently in the CRC Program

Executive managers in the two current CRCs provided names of individuals from research, government and private sector CRC member organisations in accordance with my requests regarding the occupation and organisational affiliation of desired informants. While the executive managers seemed very open and even eager for their members to participate, it is possible that their choices were made with some consideration given to the likely responses of the interviewees. While this may have introduced a managerial bias in the two “current” CRCs, the desired variation across occupations, managerial and non-managerial positions and public and private employment was achieved.

#### Recruitment of Individuals from Organisations that had Graduated from the CRC Program

The two organisations that had graduated from the CRC program no longer had a central CRC administration or management group to approach for the names of suitable individuals. Consequently snowball sampling (D. R. Cooper & Schindler, 1998), where each interviewee was asked to nominate others who had worked in the organisation, resulted in informants who were all known to each other and may have shared similar views.

Individuals from the occupations of interest, in managerial and non-managerial positions and in public and private research, government and commercial organisations were all recruited successfully.
**Interviews outside the CRC organisations**

One interview occurred with a visiting academic who was very familiar with the hybrid research organization context and primarily used sociological concepts to compare them across national cultures. Additionally the CEO of CRC in the very early stages of formation, (first CRC funding payment had not yet been received), provided insights into interactions between academic researchers and commercial manager in initial negotiations between commercial and academic groups regarding CRC staffing, budgets and financial reporting.

**Interview Schedule**

As a result of the purposive sampling frame all interviews were completed between July 23, 2004 and Dec 19, 2005. The process of reflection started during interviews and continued through transcription. The researcher used a reflective journal to note emerging patterns and ideas. The following table provides a summary of the time and location of interviews within each CRC and outside the CRC organisational context.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Number of Individuals</th>
<th>Interview Period</th>
<th>Interview Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploratory Interviews outside cases</td>
<td>3 interviewed once each</td>
<td>July 23, and Aug 12, 2004. April 1, 2005</td>
<td>Face to face, 2 at their offices, 1 at their home</td>
</tr>
<tr>
<td>BiomedGraduate</td>
<td>5, interviewed once each (1 female, 4 male)</td>
<td>Twenty weeks elapsed. Aug 12, 2004 to July 25, 2005</td>
<td>Face to face, 4 at their offices, 1 at their home</td>
</tr>
<tr>
<td>BiomedCurrent</td>
<td>3, interviewed 3 times each (all male)</td>
<td>Twelve weeks elapsed. Sep 19 to Dec 16 2005</td>
<td>Face to Face at their offices</td>
</tr>
<tr>
<td>ITGraduate</td>
<td>3, interviewed once each (1 female, 2 male)</td>
<td>Five weeks elapsed. April 8 to May 13 2005</td>
<td>Face to face, 2 at their home, 1 at his office</td>
</tr>
<tr>
<td>ITCURRENT</td>
<td>6, 5 interviewed 3 times each, 1 interviewed once (all male)</td>
<td>Twenty Nine Weeks Elapsed. May 24 to Dec 19, 2005</td>
<td>6 Face to Face at their office 10 phone due to remote location</td>
</tr>
<tr>
<td>Interviews Outside Case Organisations</td>
<td>2, interviewed once each (both male)</td>
<td>Aug 3, 2004. Sep 9, 2005</td>
<td>1 Face to Face, 1 by Phone</td>
</tr>
</tbody>
</table>
Semi-Structured Interviews

Interviews provide a way for people to speak about their experience in contexts such as commercialisation. Yin (1994) considers interviews to be one of the most important sources of case study evidence. Semi-structured interviews provided the foundation of the study and the majority of insights into the topic of occupational subcultures in commercialisation.

Interviews can vary in their tone and structure. Participants were informed of the research topic in advance but were not given questions or topic guides. Questions were selected from the research protocol by the researcher prior to the interview, and supplemented by new questions based upon themes revealed by prior interviews. This approach allowed the interviews to remain conversational while collecting comprehensive responses in a systematic and flexible way.
Appendix 10

Nvivo Coding Structure

NVivo revision 2.0.161    Licensee: Kate Hayes


NODE LISTING

Nodes in Set:  All Tree Nodes
Created:      2/05/2005 - 10:51:55 AM
Modified:     22/05/2005 - 10:51:55 AM
Number of Nodes:  134

1. (1) /Researchers
   Description: Individuals and groups who conduct research, regardless of work setting

2. (1 1) /Researchers/arrogance
   Description: Perceptions of feelings of superiority, elevation, better than others. Maybe perceived about self, or projected onto another person or group.

3 (1 2) /Researchers/Security
   Description: of employment, known environment, avoidance of novelty, of continued funding

4 (2) /Emotions
   Description: Positive and negative, loyalty, betrayal, distrust, trust

5 (2 1) /Emotions/Commitment
   Description: Sense of being strongly attached to some organisation, idea or project or the outcomes of a particular course of action.

6 (2 2) /Emotions/Trust-Sharing

7 (2 3) /Emotions/Frustration-Disillusionment

8 (2 4) /Emotions/Creating Offense

9 (2 5) /Emotions/Anxiety

10 (2 6) /Emotions/Sorrow

11 (2 7) /Emotions/Absence vs. presence of emotion
(2 7 18) /Emotions/Absence vs. ~ presence of emotion/worshipping biomed breakthroughs

(2 8) /Emotions/Embarrassment or Outrage~ethical
(2 9) /Emotions/Acceptance
(2 10) /Emotions/Greed
(2 11) /Emotions/Pride
(2 12) /Emotions/Being exploited
(2 13) /Emotions/Confusion
(2 14) /Emotions/Personal enmity~disdain for group
(2 15) /Emotions/Envy
(2 16) /Emotions/Excitement
(2 17) /Emotions/Parent~Child emotion display and control
(2 18) /Emotions/enjoyment
(2 19) /Emotions/security
(3) /Communication
(3 1) /Communication/Interactions

Description: Types of interactions

(4) /Managers - group

Description: Faceless managers, attributions made to a group

(4 1) /Managers - group/Manager - person

Description: Individual managers, personal actions attributed to an individual

(4 2) /Managers - group/Managerial Behaviour

(4 2 1) /Managers - group/Managerial Behaviour/Cohesion~Conformity

(4 3) /Managers - group/Engineers

(5) /Occupational Approach ~2 tribes~

(5 2) /Occupational Approach ~2 tribes~/explore~focus and plan

(5 2 1) /Occupational Approach ~2 tribes~/explore~focus and plan/explore~create knowledge

(5 2 2) /Occupational Approach ~2 tribes~/explore~focus and plan/focus~plan~produce

(5 3) /Occupational Approach ~2 tribes~/Commercial System

(5 3 1) /Occupational Approach ~2 tribes~/Commercial System/Market

(5 3 2) /Occupational Approach ~2 tribes~/Commercial System/Ownership
(5 3 3) /Occupational Approach ~2 tribes~/Commercial System/practical~applied

(5 5) /Occupational Approach ~2 tribes~/Academic system
Description: System of research/teaching associated with Universities, Ivory Tower, objective is pursuit of knowledge, traditionally not subject to economic assessments of outputs.

(5 5 1) /Occupational Approach ~2 tribes~/Academic system/Autonomy
Description: Choosing what to do and when to do it, exercising control, not being under the control of another. Includes strategic (what is going to be done) and operational (how it is going to be done) autonomy.

(5 5 2) /Occupational Approach ~2 tribes~/Academic system/Creativity

(5 5 3) /Occupational Approach ~2 tribes~/Academic system/dissent

(5 5 4) /Occupational Approach ~2 tribes~/Academic system/Free Sharing

(5 5 5) /Occupational Approach ~2 tribes~/Academic system/Peers~Collegial

(6) /commercialisation
Description: Specifically relating to the point at which a decision is made to bring to new knowledge to the market.

(6 1) /commercialisation/Outcomes
Description: Results, performance against measurements

(6 1 1) /commercialisation/Outcomes/Success
Description: Perceptions of, definition

(6 1 2) /commercialisation/Outcomes/Synergy

(6 1 2 1) /commercialisation/Outcomes/Synergy/skills
Description: specific skill set

(6 1 3) /commercialisation/Outcomes/symbiosis
Description: mutual dependency, (Biol.) The living together in more or less imitative association or even close union of two dissimilar organisms. In a broad sense, the term includes parasitism. For later, there are three kinds of symbiosis.

(6 2) /commercialisation/Innovation

(6 3) /commercialisation/Risk

(7) /Measurement

(7 1) /Measurement/Accountability
Description: Being held responsible for outcomes
(7 2) /Measurement/Intellectual Property
(7 3) /Measurement/Roles & Responsibilities
(7 4) /Measurement/ROI
(8) /Expressions of Culture
(8 3) /Expressions of Culture/Artefacts
(8 3 1) /Expressions of Culture/Artefacts/argumentation
(8 4) /Expressions of Culture/Visible
(8 4 1) /Expressions of Culture/Visible/Physical environment
(8 4 2) /Expressions of Culture/Visible/Symbols
(8 4 3) /Expressions of Culture/Visible/Dress–uniforms–appearance
(8 4 4) /Expressions of Culture/Visible/Language
(8 4 5) /Expressions of Culture/Visible/Physical Separation
(8 4 6) /Expressions of Culture/Visible/Rite–Ritual–Ceremony
(8 4 7) /Expressions of Culture/Visible/Stories, legends, myths
(8 5) /Expressions of Culture/Invisible ~to code on~
(8 5 1) /Expressions of Culture/Invisible ~to code on~/Personal Interactions
(8 5 2) /Expressions of Culture/Invisible ~to code on~/Beliefs and Values
(8 5 2 1) /Expressions of Culture/Invisible ~to code on~/Beliefs and Values/Researcher beliefs–values
(8 5 2 2) /Expressions of Culture/Invisible ~to code on~/Beliefs and Values/Commercial beliefs–values
(8 5 3) /Expressions of Culture/Invisible ~to code on~/Assumptions
(8 5 3 1) /Expressions of Culture/Invisible ~to code on~/Assumptions/Research Assumptions
(8 5 3 2) /Expressions of Culture/Invisible ~to code on~/Assumptions/Commercial Assumptions
(8 5 6) /Expressions of Culture/Invisible ~to code on~/norms
(8 5 6 4) /Expressions of Culture/Invisible ~to code on~/norms/Researchers' norms
(8 5 6 5) /Expressions of Culture/Invisible ~to code on~/norms/Commercial norms
(9) /Commercialisation Models
(9 1) /Commercialisation Models/Chainlink Innovation
Description: Perceptions of what, and who, belongs and who is outside a group, where the "fences" are located.

Description: Attempts to manage the impact of mismatching assumptions, overt disagreement and non-cooperation.

Description: Being accepted in more than one community. Also, career and occupational changes eg research to business. Also processes that cross over occupational boundaries, eg DCP

Description: between research, government and commercial partners

Description: Obstacles to achievement, in the widest sense. 12/9/05 May later become a parent node.

Description: Disagreement, non-cooperation, overt and covert (possible tree 12/9/05)

Description: Urgency, timeframe, deadline, timelines, grant cycle, prototype delivery

Description: Movement from pre-existing state. Change in its widest sense. Possible tree 12/9/05

Description: perceived attitudes towards waiting, delays, orientations towards past, present and future, symbolic or metaphoric value of time and perceptions about the "efficient" use of time (from Ian McDuff, Negotiation Journal, 2006, 22(1)).

Strong links to "time is money" theme
99  (11 4) /Time/Flexibility~Punctuality~Poly~mono
Description: Covers punctuality, clock time vs. event time, overlaps between work and
social time and polychronic/synchronic distinctions (from Ian McDuff, Negotiation
Journal, 2006, 22(1)). I'm adding autonomy over time in here as well
100  (11 5) /Time/Subcontracting research
101  (11 6) /Time/Point of Commercial Opportunity
102  (12) /Research Institutions
Description: EG. Uni, CSIRO, Govt funded Laboratory
103  (12 1) /Research Institutions/Flexibility~Inflexibility
104  (12 2) /Research Institutions/Funding
Description: Means of getting funding to support research
105  (12 2 1) /Research Institutions/Funding/Monetary Incentives
106  (12 2 2) /Research Institutions/Funding/Research Grants
107  (13) /CRC
108  (13 1) /CRC/CRC Organisation Structure
109  (13 1 1) /CRC/CRC Organisation Structure/Complexity
Description: Multiple factors, many to many relationships, lack of simple, one to one or
causal certainties.
110  (13 1 1 1) /CRC/CRC Organisation Structure/Complexity/Co-opetition
111  (13 1 2) /CRC/CRC Organisation Structure/Contracts
112  (13 1 3) /CRC/CRC Organisation Structure/politics
Description: macro and intra-CRC stakeholder perceptions of control and influence
113  (13 2) /CRC/CRC Org Culture
Description:
114  (13 2 1) /CRC/CRC Org Culture/Contradictions
Description: Between espoused and lived values, may arise from different sources, eg
structural or individual or cultural
115  (13 2 2) /CRC/CRC Org Culture/Metaphor
116  (13 2 3) /CRC/CRC Org Culture/Secondment
117  (14) /Motivation
118  (14 1) /Motivation/Knowledge-Making
119  (14 1 1) /Motivation/Knowledge-Making/Prestige~Status
Description: Feelings of worth or worthlessness, prestige, status, being held in high
esteem. Extended to include notion of employment status, eg part time contractor
working to management direction.
120 (14 1 2) /Motivation/Knowledge-Making/Publication
121 (14 1 3) /Motivation/Knowledge-Making/Recognition
122 (14 1 4) /Motivation/Knowledge-Making/Reputation
123 (14 2) /Motivation/Rewards
124 (14 2 1) /Motivation/Rewards/Money
125 (14 2 2) /Motivation/Rewards/Reputation~Publication~Recognition
126 (14 3) /Motivation/Money-Making
127 (15) /Group~Grid dimension
128 (15 1) /Group~Grid dimension/Group Dimension
Description: group dimension of occupation
129 (15 1 1) /Group~Grid dimension/Group Dimension/Community
Description: Group with strong sense of commonality
130 (15 1 2) /Group~Grid dimension/Group Dimension/Hierarchy~Grid Dimension
Description: Levels of control and power, grid dimension of occupation
131 (16) /Org Culture Theories
132 (16 1) /Org Culture Theories/Differentiation
133 (16 2) /Org Culture Theories/Functional
Description: Functional view of culture
134 (16 3) /Org Culture Theories/Integration
Appendix 11

Invitation to Participate in the Research

(UWS Letterhead)

Name
Address

Dear ..........,

I would like the opportunity to introduce myself. I'm a PhD student, investigating how different occupations interact in the process of transforming a scientific discovery into a commercial product. My academic qualifications include a B.SC with First Class Honours from UNSW and an MBA from UTS. In terms of work experience, eighteen years were spent in the IT industry in Australia and New York. In those eighteen years I observed, and became fascinated by, the potential of human interactions to accelerate or hinder the progress of technology based projects.

Commercialisation is acknowledged to be a difficult stage of the innovation process. Previous studies have considered funding, organisation size and structure and Intellectual Property rights as factors influencing the outcome of commercialisation efforts. However, little research seems to have considered the influence of occupational interactions in an organisation’s shift from knowledge-making to money-making.

Specifically I am looking for two new, and two well-established CRCs (or Direct Research Spin Offs). Participation in the research would consist of one hour interviews with three or four people in the well-established CRCs, or a series of interviews with three or four people in the newly established CRCs. It is envisaged
that the series of interviews with the members of new CRCs would be 30 minutes in duration and occur approximately 8 weeks apart over a period of 12 months.

Potential benefits to the CRCs participating in the research would include the opportunity to reflect upon interactions between scientific and commercial personnel in their organisation and contribute to the effectiveness of commercialisation in Australia. The study is independent. It is not commissioned or funded by Federal or State governments, and ethics approval has been granted by the University of Western Sydney’s Human Research Ethics Committee. All details of organisations and individuals participating in the research will be kept confidential.

I would greatly appreciate it if I could meet with you to discuss the research and hear your views on the experience of moving from knowledge-making to money-making, and whether people in the professions you have worked with show signs of possessing different beliefs and values or show distinctive signs of belonging to a particular group.

I will call you in the near future to discuss a time that would suit your schedule, or if you prefer, call me on 0416 304 447 or email me at katehayes@optushome.com.au

Best Regards,

Kate Hayes
Demographic Questionnaire

An Investigation into Patterns of Interaction from Laboratory to Market.

DEMOGRAPHIC QUESTIONNAIRE

1. ____ Age: ……………

2. ____ Gender: Male □ Female □

3. ____ Country of Birth: ……………………………………………………..

4. ____ Educational Qualifications

(If you hold more than one degree please write the number next to the box)

Year 10 □
HSC or equivalent □
Undergraduate Degree(s) □ How Many
Postgraduate Certificate/Diploma □
Postgraduate Degrees
  Masters □
  Doctorate □
  Post Doctoral Fellowship □

Other …………………………………………..
5. **Occupation**

What is your title? .................................................................

To which broad occupational group do you belong?
(If your role spans two groups, e.g., Engineering Manager, please select the group where you hold your academic qualifications)

- [ ] Scientific
  Primary discipline e.g. Physicist, Computer ............................

- [ ] Managerial/Commercial
  Primary Discipline e.g. Human Resources, CEO .........................

- [ ] Engineering
  Primary Discipline e.g. Mechanical, Electrical ...........................

6. Are you working on secondment from another organisation, e.g. a university or CSIRO?

  Yes [ ]  
  No [ ]  
  (If no, go to question 9)

7. If on secondment what is the name of your permanent employer?

  ................................................................................................

8. Do you expect to return to this employer at the end of this commercialisation work?

  Yes [ ]  
  No [ ]

9. How long have you worked in this organisation?

10. How many employers have you worked for since graduating?

THANK YOU FOR YOUR ASSISTANCE.
# Appendix 13

## Demographic Data

<table>
<thead>
<tr>
<th>IT Graduate</th>
<th>Age</th>
<th>Gender</th>
<th>Education</th>
<th>Occupation</th>
<th>Physical Secondment Status</th>
<th>Length of Employment</th>
<th>No. of Employers</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEO</td>
<td>57</td>
<td>Male</td>
<td>PhD</td>
<td>Researcher</td>
<td>Yes</td>
<td>23 yrs</td>
<td>2</td>
</tr>
<tr>
<td>Comms. Mgr</td>
<td>64</td>
<td>Female</td>
<td>Bachelor</td>
<td>Commercial</td>
<td>No</td>
<td>12 yrs</td>
<td>6</td>
</tr>
<tr>
<td>Director of Technology</td>
<td>45</td>
<td>Male</td>
<td>PhD</td>
<td>Researcher</td>
<td>No</td>
<td>3 yrs</td>
<td>5</td>
</tr>
</tbody>
</table>

| BioMed Graduate | | | | | | |
|-----------------|-----|--------|-----------|------------|---------------------------|---------------------|------------------|
| Chief Scientist | 59  | Male   | PhD (PostDoc) | Researcher | Previously seconded | 27 yrs              | 2                |
| Engineer        | 42  | Male   | Bachelor  | Commercial Engineer | No     | 3 months              | 7                |
| Project Scientist | 38  | Male   | PhD (PostDoc) | Researcher | Yes | 10 years              | 3                |
| Project Scientist | 47  | Female | PhD      | Researcher Manager | No | 17 years              | 4                |
| Chief Fin. Officer | 46  | Male   | Masters  | Commercial | Yes | 2 years               | 7                |

<p>| IT Current | | | | | | |
|-------------|-----|--------|-----------|------------|---------------------------|---------------------|------------------|
| CEO         | 47  | Male   | Masters  | Researcher | No                        | 2 yrs               | 5                |
| Bus Manager | 36  | Male   | PhD      | Commercial | No                        | 1 year              | 3                |
| Assoc Prof  | 42  | Male   | PhD      | Research Engineer | No | 1 year               | 4                |
| Government Executive Manager | 52  | Male   | Post Grad Dip | Commercial | No | 34 years              | 1                |
| MD, Private Co | 50  | Male   | Masters  | Commercial | No                        | 4 years              | 3                |</p>
<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Education</th>
<th>Self-Identified Occupation</th>
<th>Physical Secondment Status</th>
<th>Length of Employment</th>
<th>No. of Employers</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Male</td>
<td>PhD (Post Doctoral)</td>
<td>Research Engineer</td>
<td>No</td>
<td>8 years</td>
<td>1</td>
</tr>
<tr>
<td>36</td>
<td>Male</td>
<td>Bachelor</td>
<td>Commercial</td>
<td>No</td>
<td>9 years</td>
<td>8</td>
</tr>
<tr>
<td>30</td>
<td>Male</td>
<td>3 Masters</td>
<td>Commercial Engineer</td>
<td>No</td>
<td>13 years</td>
<td>4</td>
</tr>
<tr>
<td>55</td>
<td>Male</td>
<td>PhD</td>
<td>Researcher</td>
<td>No</td>
<td>26 years</td>
<td>1</td>
</tr>
<tr>
<td>47</td>
<td>Male</td>
<td>Bachelor(Hons)</td>
<td>Commercial</td>
<td>No</td>
<td>15 years</td>
<td>4</td>
</tr>
</tbody>
</table>

**N.B.** Country of birth removed to protect anonymity.
Appendix 14

Excerpt from Reflective Journal
Showing Interplay of Interview, Theory and Purposive Sampling

Oct 4 2005

After interview with GM Private Co, IT New

Important for discussion of argumentation as an occupational cultural obstacle to commercialisation: Researchers can debate, outsiders cannot because they do not have membership or status within the occupational community. Consistent with science being a closed community. Blind spots on both sides evidenced by management "fear" of scientific debate and intellectual dissent AND scientists' "fear" of inspection by and engagement with business managers? Fits with rejection of anyone other than researchers as judges of research. T has not witnessed argumentation but agrees with N, there is an unwillingness to engage in interaction with members of other occupational groups if their activities are being questioned or inspected regardless of intent of questions.

Divergent assumptions about the purpose of a CRC as described by GM of new Biomed CRC in establishment phase. Academic point of view "This is how we get our research funding now, therefore pad the budget as much as possible."

Industry point of view "We're going to produce something that results in a business and be subject to fiduciary scrutiny therefore we need to be exact." Perceptions of internal budget games vs. fear of substantial, externally imposed penalty.

Perhaps scientific argumentation has evolved as a culture-specific ritual to increase the number and variety of ideas, and to signal membership of the group. Outsiders are excluded. Opposite developmental path in business culture, desires for cohesion leads to
distrust of new ideas and rewards conformity of words and actions. Leads to a Nexus in verbal interactions in CRCs. Commercial people bring big business verbal expectations and forms into small CRC organisation that has developed primarily from an academic pre-history. Science brings its academic forms of argumentation (see Ziman) into heterogenous CRC groups.

Other professions use disputational argumentation, legal and academia. Possible route for its adoption by scientific occupational subcultures is from their academic training and often postgraduate employment within academic institutions?

Adaptors vs. Innovators. As engineers are located on the "less professional" end of Kerr et al’s continuum, do they hold norms less strongly, are they less cohesive and does this result in greater adaptability within organisations?
Appendix 15

Description of CRCs, Informants and Interview Material Collected

A brief description of interview duration in each of the four CRCs participating in the research appears below.

IT Current CRC

The IT Current CRC had recently commenced operations. Over eight hours of semi-structured interviews were conducted during sixteen interview occasions. Each person in the current CRCs was interviewed three times, in accordance with the longitudinal research design for CRCs presently in the program. The exception was a researcher who was interviewed only once as he was not currently involved in CRC affiliated work, and nominated a replacement who was a project leader for the CRC. Two individuals from the CRC’s management group, a manager from a government trading body, a university researcher and the manager of a private company participated in the interview schedule.

IT Graduate CRC

The IT Graduate CRC had recently ceased operations. During the course of its participation in the CRC program it had spun off several successful start-up organisations. Over four hours of interview material was collected from the three interviews conducted with three individuals, two of whom had held management positions and one researcher while in the CRC.

Biomedical Current CRC

Three individuals were each interviewed three times, producing over six hours of interviews. They were an engineer in a private company, a manager in a customer service centre and a researcher in a government research laboratory.
**Biomedical Graduate CRC**

Upon graduating from the CRC program this organisation listed on the Australian Stock Exchange. Interviews occurred with four individuals who had worked in the organisation but had since left. Of these two researchers had returned to a government research institution, an engineer had moved to an established biomedical company and a manager was leading a biomedical start-up. An interview was conducted with a senior researcher still employed by the company developed from the Biomedical Graduate CRC. More than six hours of interviews occurred.

**Interviews Outside the Four CRC Organisations**

Three people working outside the four CRC organisations primarily examined in the research were also interviewed. They were a manager was in the very early stages of starting a biomedical CRC, an academic working in the field of cross-cultural comparisons of national systems of innovation and an innovation manager in a private company who has since been appointed to a government position associated with the CRC program. More than two hours of interview data was collected.
## Appendix 16

**Self Reported Secondment Status**

<table>
<thead>
<tr>
<th></th>
<th>Seconded</th>
<th>Not Seconded</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Graduate</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>IT Current</td>
<td>0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Biomed. Graduate</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Biomed. Current</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Interviews Outside CRC Organisations</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>4</td>
<td>13</td>
<td>17</td>
</tr>
</tbody>
</table>

*Full demographic data was not available for two of the outside CRC interviews.*

*Source:* Demographic questionnaires completed at first interview.
## Appendix 17

**Gender of Informants, Total and by CRC**

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Graduate</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>IT Current</td>
<td>0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Biomed. Graduate</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Biomed. Current</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Interviews Outside CRC*</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>2</td>
<td>18</td>
<td>20</td>
</tr>
</tbody>
</table>

* Full demographic data was not available for two of the outside CRC interviews.

Source: Demographic questionnaires completed at first interview.
Appendix 18

Age of Informants

A spread of informant age groups of informants was represented in each of the CRCs. The youngest person interviewed was 36 and the oldest 64 years old. The age of informants is well suited to the research interest in interactions between occupations. This is because younger individuals in CRCs, such as post-graduate students, tend to work within the occupational boundaries of their discipline under the guidance of a supervisor from the same community. As such, they may have less inter-occupational experience to draw upon as informants for the research.

<table>
<thead>
<tr>
<th>IT Graduate</th>
<th>36 – 40</th>
<th>41 – 45</th>
<th>46 – 50</th>
<th>51 – 55</th>
<th>56 - 60</th>
<th>61 - 65</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Current</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Biomed. Graduate</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Biomed. Current</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Interviews Outside CRCs*</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>18</td>
</tr>
</tbody>
</table>

* Full demographic data was not available for two of the outside CRC interviews.

Source: Demographic questionnaires completed at first interview.
Appendix 19

Length of Employment in CRC Member Organisations

The informant group possessed a range of years of service within CRC member organisations. One informant had left the CRC after only three months employment. However, despite the short duration of his CRC employment he was considered able to contribute to the research as he attributed much of his motivation for leaving to inter-occupational frustration. Seven participants were employed for less than five years while four interviewees had worked for more than twenty years in their CRC member organisations. The total range of employment in member organisations was three months to thirty-four years, providing individuals with a spread of experience likely to illuminate the nature and impact of inter-occupational contact in a variety of organisational stages.

<table>
<thead>
<tr>
<th></th>
<th>&lt; 5 years</th>
<th>6 – 10 years</th>
<th>11 – 15 years</th>
<th>16 – 20 years</th>
<th>21 + years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Graduate</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>IT Current</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Biomed. Graduate</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Biomed. Current</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Interviews</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Outside CRCs*</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>7</strong></td>
<td><strong>3</strong></td>
<td><strong>3</strong></td>
<td><strong>1</strong></td>
<td><strong>4</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

* Full demographic data was not available for two of the outside CRC interviews.

Source: Demographic questionnaires completed at first interview.
Appendix 20

Informants’ Highest Educational Qualification.

The exploratory interviews suggested post-graduate qualifications might be an occupational boundary construct. To assist in examining this, the demographic questionnaire requested information about the interviewees’ educational qualifications. The demographic data in Appendix 13 and shown below reveal a collection of highly qualified individuals. All eight researchers possessed a Doctorate. One engineer held a Bachelors degree; one held Masters Degrees and two held Doctorates. Of the managers, one held a Higher School Certificate; two held Bachelors; four held Masters and one held a Doctorate. The small size of the sample and purposeful recruitment procedure preclude any attempts to generalise beyond the sample, nor is the research designed to be deductive. However, as the table below shows, as a group researchers held higher academic qualifications.

<table>
<thead>
<tr>
<th></th>
<th>Diploma</th>
<th>Bachelor</th>
<th>Masters</th>
<th>PhD</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researcher</td>
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<td>0</td>
<td>0</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Engineer</td>
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</tr>
<tr>
<td>Manager</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>11</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Demographic questionnaires completed at first interview.