Management Control Systems and Open Strategy Processes – a Resource Dependence perspective

Paul J. Thambar[1*]

David A. Brown[1]

Prabhu Sivabalan[1]

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[1] UTS Business School, University of Technology Sydney, Australia

[*] corresponding author at UTS Business School, University of Technology, Sydney, PO Box 123, Quay Street, Haymarket, NSW 2007, Australia. Tel: + 61 419496154.

Email: paul.thambar@uts.edu.au

Abstract

Strategy processes have become more open in recent years, extending beyond organizational boundaries and involving collaborative strategic activities between organizations. However, there is limited accounting research on these open strategy processes and the role of management control systems. Through a field study in the Australian cotton industry analysed using resource dependence theory, we find that resource constraints arising from strategic uncertainties which are not controlled by any single organization make organisations mutually dependent, thereby incentivising open strategy processes. We also outline how management control systems facilitate these open strategy processes by helping to establish cooperation, coordination of strategic activities and enabling resource appropriation. We contribute to resource dependence theory by providing an empirical and theoretical extension, showing how organizations manage mutual resource dependencies. We also contribute to management accounting theory by introducing open strategy processes and explaining how management control systems are used as industry-level mechanisms to control open strategy processes.

Key words: open strategy process, resource dependence theory, management control systems

Introduction

How do organizations use the strategy process (Chenhall, 2003, Langfield-Smith, 2007, 1997) to manage strategic uncertainties (Simons, 1995, 1990) beyond their control and resources? A developing stream of accounting research (Dekker, 2004, 2003, Hakansson & Lind, 2007) has examined collaborative relationships[1] (dyadic or network) between organizations which have arisen to help organizations manage a range of functional issues (eg: supply chain efficiencies). These inter-organizational relationships are ultimately designed to manage resource dependencies (Pfeffer & Salancik, 1978). However, collaborative relationships involving strategy processes have received virtually scant attention in accounting research.

Collaborative relationships are designed to help organizations manage resource dependencies (Hillman, Withers & Collins, 2009, Pfeffer & Salancik, 1978). The inter-organizational relations that result create asymmetrical dependencies between organisations, with the organization controlling resources holding leverage over the organization needing these resources (Casciaro & Piskorski, 2005). Resource dependence theory (RDT) has an inbuilt assumption that for Organization X, its strategic uncertainties are controlled by Organization Y through the latter's access and control to resources required by Organization X. Therefore, RDT provides a range of strategic options (eg: mergers and acquisition, joint ventures etc) which are structured to help Organization X overcome it strategic uncertainty by reducing its resource dependence on Organization Y (Casciaro & Piskorski, 2005). However, when the strategic uncertainty of Organization X is not controlled by any other organizations in its environment and moreover, when Organization X, Organization Y and all other organizations are faced with the same strategic uncertainty, conditions are created for mutual dependence between these multiple organizations. An individual organization's strategy process is incapable of developing an appropriate strategic response as it lacks the resources to manage the strategic uncertainty (Chesbrough & Appleyard, 2007).

Strategy processes have been kept opaque (Porter, 1991, 1985, 1980) but are now "opening" to enable collaboration between organizations (Chesbrough & Appleyard, 2007, Whittington, Cailluet & Yakis-Douglas, 2011). These open strategy processes are more inclusive and transparent with multiple organizations sharing activities and resources to develop strategic

[1] Dyads involve two organizations forming collaborations (Dekker, 2004). Network relationships involve multiple organizations forming collaboration around a focal organization (Hakansson & Lind, 2004).

information (Whittington et al, 2011). The hierarchical focus, with one dominant organization (Dekker, 2004) which has characterised current inter-organizational relationships (dyadic and network) appears to be absent with multiple organizations participating in the open strategy process as equals. This open strategy process, a new form of collaborative relationship, appears to be well suited to handle collaborations where all participants are mutually dependent because of a common strategic uncertainty beyond their collective control or resources. But, we have limited understanding of these open strategy processes in accounting research.

We have two aims in this paper. Our first aim is to explore and explain how a common strategic uncertainty provides incentives for multiple organizations to be incentivised to engage in open strategy processes. In doing so, we hope to address recent calls in the accounting literature to examine accounting and control issues related to "parity-based forms of alliances" where no dominant organization can 'choose or force any control option against the interests and willingness of other partners" (Caglio & Ditillo, 2008, p894). Our second aim is to explore and explain how open strategy processes are "controlled". Our focus is on explaining how management control systems (MCS) are used to enable organizations to cooperate, to coordinate strategic activities and to ensure resource appropriation in open strategy processes. We report on a field study in the Australian cotton industry where open strategy processes have been used.

Our study provides three contributions to accounting theory. First, we introduce a new form of inter-organizational relationship, open strategy processes, to the accounting literature and extend our understanding of strategy processes by developing knowledge on how organizations collaboratively engage in strategic activities beyond the organizational boundary. Second, we extend our understanding of resource dependence theory by explaining how organisational actions driven by resource dependence logics align to the generation of an open strategy. We explain how organizations manage interdependence when faced with common strategic uncertainties which are beyond the resource capabilities of individual organizations (Pfeffer, 1987). By doing so, we provide support to Casciaro & Piskorski (2005) by empirically demonstrating how organizations manage mutual dependencies by collaborating to bypass constraints by eliminating them, as opposed to absorbing them or reducing their value, as explained in prior research (Davis and Cobb, 2009). Finally, we show how open strategy processes are enabled by management control systems. MCS operate as

industry-level collaboration mechanisms, assisting with cooperation, coordination of strategic activities and sharing of organizational resources (Caglio & Ditillo, 2008). This extends our understanding of the role of MCS by providing knowledge on how they can be used, between organizations, in open strategy processes.

Our paper is organised as follows. The next section includes our theoretical framework for the study. Following this, we outline our research method and data and findings. Next, we provide a brief discussion of our findings and then conclude.

Theoretical Framework

Open Strategy Processes

The management literature on open strategy processes approach this phenomenon from two perspectives. Chesbrough & Appleyard (2007) approach open strategy processes from a "content" perspective and describe two key constructs: open invention and open coordination. Open invention refers to the use of pooled knowledge from different contributors to generate new ideas for products and operational activities. Open invention takes place through knowledge exploration, knowledge retention and knowledge exploitation which are open R&D and innovation activities carried out by organizations. Open coordination refers to the antecedent mechanisms enabling the collaboration between organizations as they carry out open invention activities. These mechanisms help to build consensus and cooperation between employees of organizations, help to coordinate activities related to knowledge exploration, knowledge retention and knowledge exploitation and manage resource appropriation between organizations to carry out open strategy activities (Caglio and Ditillo, 2008). As described by Chesbrough and Appleyeard (2007, p64), "a critical element to coordinating the value created through open inventions is some underlying architecture that connects the different pieces of knowledge together".

Whittington et al (2011) describe open strategy processes from a "process" perspective, focusing on how the strategy process has become more inclusive and transparent. They argue that open strategy processes are more inclusive and include not only senior managers but all managers in organizations. Open strategy processes are also more transparent with strategic information and activities made visible to managers within organizations and to external stakeholders (Whittington et al, 2011).

In our study, we combine these two perspectives and define open strategy processes as consisting of strategic activities involving all managers within the organization and their counterparts in other organizations with whom they collaborate. These strategic activities enable managers to carry out open invention activities and also enable open coordination to ensure the proper operation of open strategy processes. Examples of strategic activities included in open strategy processes are research and development (R&D) and innovation (Chesbrough & Appleyard, 2007). This has involved sharing of resources to develop new ideas and information that can be brought back to improve organizational strategy processes (Chesbrough & Appleyard, 2007, Chesbrough, 2007, 2006, 2003, Hamel, 1996, Matzler et al., 2014, Newstead and Lanzerotti, 2010, Steiger et al., 2012, Whittington et al., 2011).

The reasons behind why an intra-organizational process, which enables the organization to develop a competitive advantage, is opened up and becomes a collaborative inter-organizational process has had limited attention in the accounting literature. Our knowledge of open strategy processes is limited in two important areas. First, we have limited understanding of the incentives available to organizations to engage in open strategy processes. Under what circumstances do strategic uncertainties create incentives for organizations to open up their strategy processes to other organizations including competitors? Second, we have limited understanding of the collaboration mechanisms available to organizations to enable them to collaborate and carry out open strategy processes? Even if organizations have incentives to engage in open strategy processes, what mechanisms are available to them to enable and facilitate this engagement?

Organizations are open systems influenced by their external environments (Hillman, Withers & Collins, 2009). In their theory of resource dependence, Pfeffer and Salancik (1978) argued that "organizational activities and outcomes are accounted for by the context in which the organization is embedded" (p 39). An organization's activities and outcomes are influenced by other organizations in the environment. The primary function and purpose of many organizations is the control and alteration of the activities of other organizations (Pfeffer & Salancik, 1978), principally for purposes of reducing or managing uncertainty. Resource dependence theory provides a basis for understanding why inter-organizational relations exist (Nienhuser, 2008), and contains within it the capacity to explain why organisations choose to collaborate, and how. The inter-organisational setting observed within this study aligns to the

central tenets of RDT, and sheds light on the manner by which RDT contributes to strategy development and implementation in organisations.

Pfeffer (1987, p26-27) summarised the basic arguments of the resource dependence perspective and inter-organizational relations as: "(1) the fundamental units for understanding inter-corporate relations and society are organizations; (2) these organizations are not autonomous, but rather are constrained by a network of interdependencies with other organizations; (3) interdependence, when coupled with uncertainty about what the actions will be of those with which the organizations interdependent, leads to a situation in which survival and continued success are uncertain; therefore 4) organizations take actions to manage external interdependencies, although such actions are inevitably never completely successful and produce new patterns of dependence and interdependence; and 5) these patterns of dependence produce inter-organizational as well as intra-organizational power, where such power has some effect on organizational behaviour".

Pfeffer & Salancik (1978) defined an organization's external environment as consisting of other organizations on which it depended on for resources and support (Wry, Cobb & Aldrich, 2013). The definition of resources that organizations seek to obtain from the environment is broad and includes any items required by the focal organization to carry on its business (Casciaro & Piskorski, 2005, Pfeffer & Salancik, 1978). This understanding of the external environment and external resources implies that any strategic uncertainties that have the potential to reduce or hinder the choices available to an organisation can be problematic from a strategy and resourcing perspective.

To manage such constraints, Pfeffer and Salancik (1978) put forward three choices – diffuse the constraint, absorb it or co-opt it. A central tenet of RDT is the existence of strategic uncertainties that cause organizations to reflect on their interdependence. Typically, this interdependence is investigated between members of a dyadic alliance (Pfeffer and Salancik, 1978, Hillman, et al 2009). In any industry, organizations are faced with many strategic uncertainties that impact on their ability to access resources to carry on their business. These strategic uncertainties arise from a range of external factors including social, technological, ecological, economic and political issues (Johnson, Scholes and Whittington, 2005). Ecological factors are the defining strategic uncertainty for organizations in many industries (Johnson, et al., 2005, Hart, 1995, Shrivastava, 1995).

Theoretically, the strategic uncertainty posed by ecological factors reveals new attributes in comparison to those commonly defined in RDT studies. Strategic uncertainties typically arise as issues related to capability and opportunity of another organisation that constrains the choices available to one's own organisation, driving a decision to collaborate (Wry, et al, 2013). Organisations might attempt to bypass these constraints but in the main, attempt to absorb them (Casciaro and Piskorski, 2005). Proponents of resource dependence theory advocate practices such as mergers and acquisition, joint ventures co-optation and others as examples of dependent organisations absorbing the constraints of their partners, in order to be able to exercise greater control over them (Wry, et al , 2013). However, RDT also possesses within it the theoretical capacity to richly cognise strategic uncertainties that drive interdependence and resource sharing that is driven by a wholly external source to organisations which commonly impacts all dependent organisations similarly, and is too costly for any one organisation to address, such as an ecological threat commonly experienced by all firms in an industry. In this manner, the same constraint absorption exists, which requires a multi-organisational response beyond dyadic alliances. To date, these responses have not been conceptually or empirically explained (Casciaro and Piskorski, 2005) in the literature.

A plausible effect of common strategic uncertainties is to drive high mutual dependence between organizations, but this style of relationship has only been conceptually examined for a dyadic alliance. Casciaro and Piskorski (2005) reveal this option, in their matrix of interactions. In a dyadic relationship, the focal organization becomes increasingly resource dependent on the organization controlling the resources required by the focal organization (Casciaro & Piskorski, 2005, Pfeffer & Salancik, 1978). However, when multiple organizations are impacted similarly by a common strategic uncertainty, they are all resource constrained and become mutually dependent (Casciaro & Piskorski, 2005). The central tenets of resource dependence theory thus hold, consistent with Pfeffer (1987) – organizations yield to interdependence in order to manage an uncertainty borne from a resource constraint. This is done by undertaking strategic endeavours to bypass the constraint (i.e. render it irrelevant) by not only diminishing its value (Pfeffer and Salancik, 1978) but wholly eliminating it. Theoretically, therefore, the novelty of this pursuit arises from the source of this constraint being external to any one organization in the relationship, the interdependence between organizations extending beyond the dyadic form and the manner by which the constraint is

being tackled being not one of absorption, or traditional bypassing (reducing the value of the constraint), and therefore less investigated in studies to date.

Organizations, in a situation of mutual resource dependence, have incentives to collaborate and engage in open strategy processes to pool and share organizational resources, carry out strategic activities together and develop new information that can be used to develop organizational strategies that enable absorption or elimination of resource constraints.

MCS and open strategy processes

The second aim of this paper is to explore how open strategy processes are "controlled". Management control systems have an important role *within* an organization enabling collaboration by aligning managerial behaviours and coordinating and resourcing activities to achieve strategic objectives (Chenhall, 2003, Flamholtz, et al., 1985, Malmi & Brown, 2008). These systems help to manage control problems within the organization: lack of direction, lack of motivation and lack of skills and capabilities (Merchant & Van der Stede, 2012).

There is a burgeoning literature on MCS and inter-organizational relationships (Caglio & Ditillo, 2008, Dekker, 2004, 2003, Hakansson & Lind, 2007). The focus in this stream of research is on understanding the types of inter-organizational relationships and on the design of appropriate MCS mechanisms to control these inter-organizational relationships.

The principal focus on inter-organizational relationships and MCS has been on the dyadic relationship (Dekker, 2004, 2003, Hakansson & Lind, 2007). The emphasis has been on understanding how best to control the ability of each member of the dyad to cooperate and share resources to achieve strategic goals that are unique to each organization in the relationship. This focus has led to the investigation of what types of structures are appropriate for the inter-organizational relationship (e.g. joint ventures or alliances) and therefore what MCS should be designed and used (Dekker, 2004, 2003, Hakansson & Lind, 2007). Each firm in the relationship has retained their own unique competitive and operational strategies (Dekker, 2004, 2003) and has operated as a "tenant in a shopping centre" with interactions limited to securing information specific to their individual needs.

Another type of inter-organizational relationship, network relationships, has had a limited focus in the accounting literature (Hakansson & Lind, 2007). Networks are based around multiple relationships held by firms usually involved in a supply chain relationship

(Hakansson & Lind, 2007). These networks are also established around a single firm which operates at the centre of the network (Mahama & Chua, 2005).

Caglio & Ditillo (2008) have argued that the focus of the accounting literature on control systems and inter-organizational relationships has been on "control solutions" and less on "control problems" which the control systems are designed to manage. A focus on "control problems" helps to understand the control context and enables design of effective "control solutions".

Inter-organizational relationships such as open strategy processes have three types of control problems that need to be managed (Caglio & Ditillo, 2008). First, organizations involved in a collaboration need to be incentivised and assisted to cooperate to share information and resources (Flamholtz, 1996). This cooperation needs to take place in an atmosphere of mutual trust which needs to be established and developed over time (Dekker, 2004, 2003). Second, the strategic and operational activities of organizations involved in the collaboration needs to be coordinated and scheduled to avoid overlaps, inconsistencies and unnecessary waste of resources (Dekker, 2004, Flamholtz et al, 1985). Finally, the appropriation of resources and the sharing of benefits of the collaboration needs to be managed equitably (Caglio & Ditillo, 2008). In order to effectively function in this manner, these control systems need to operate at an industry-level, between multiple organizations.

While, the design and use of MCS to manage these three control problems related to inter-organizational collaborations have been a focus to a various extent in dyadic and network relationships, our understanding of how these MCS are designed and used in open strategy processes is limited (Chesbrough & Appleyard, 2007). Our study aims to fill this important gap in the accounting literature.

Research Method

We carried out a field-based exploratory case study in the Australian cotton industry to understand the operations of an open strategy process and how management control systems were deployed and used to enable these processes. A case study approach is recommended for research questions which are exploratory, examining *how* a phenomenon occurs (Chua, 1996, Yin, 2003). This approach is also recommended for a deeper understanding of the phenomenon (Ahrens & Dent, 1998). Case work enables development of knowledge of the world of practice, allowing researchers to gain a deeper appreciation of strategy processes and MCS in their natural settings (Chua, 1996, Keating, 1995). Open strategy processes are a recent development in the field of strategy and therefore, an exploratory case study was considered to be an ideal approach to develop knowledge of these processes.

Open strategy processes operate at the inter-organizational level and involve multiple organizations and managers. The collaboration mechanisms that relate to this open strategy process operate at an inter-organizational level but have their origins within individual organizations. The antecedent factors that operate as incentives for organizational engagement in these processes are external but have strategic impacts within individual organizations. Therefore, the "unit of analysis" which locates the research study also needs to span organizational boundaries and be at the inter-organizational level (Paton, 2002, Yin, 2003). The location of the research study must also enable comparability with future research studies on this topic. For these reasons, the "unit of analysis" for this study was the open strategy process.

The exploratory case study based approach was undertaken to develop theoretical knowledge by examining the empirical phenomenon of open strategy processes and identifying the antecedent factors and collaboration mechanisms that enabled these processes (Chesbrough & Appleyard, 2007, Yin, 2003). The case setting is the Australian cotton industry and the open strategy process empirically observed in this setting. The field work to collect data was carried out over a two year period (January, 2012-December, 2013), mainly, through four field trips to the main cotton growing regions in New South Wales and Queensland. The period of investigation covered a longitudinal timeline representing 52 years (1962-2014). During the two year period of field work, two of the researchers were closely involved as observers with key individuals and firms in the Australian cotton industry.

The primary data source for the study was a set of 54 interviews with 48 individuals lasting 59 hours (Appendix 1). These interviews included cotton growers, cotton researchers, cotton agribusiness consultants, cotton merchants and cotton administrators and managers drawn from key organizations within the Australian cotton industry. The interviews were semi-structured and focused on specific issues and topics related to open strategy processes and a range of questions were prepared prior to each interview. The majority of interviews were tape recorded and transcribed and were conducted by, at least, two researchers. Some interviews were not taped but extensive notes were made of the responses.

In addition to interview data, a range of archival documents (refer Appendix 2) were considered in the research study. These documents included annual reports, strategic plans, minutes of board and other committee meetings, industry reports, books, Australian Cotton conference proceedings and papers and website information and documents. These archival documents provided a range of important data including background on the industry and key organizations and managers, establishment and operation of industry organizations, administrative mechanisms (eg: cotton conferences, industry committees), strategic plans and performance measurement mechanisms (eg: environmental audits).

Interview and archival data was combined with field observations of managers and their activities (refer Appendix 3). Over 33 hours of observations were conducted through a number of field trips over a 2 year period. The observations included formal meetings of managers from industry organizations, industry and regional conferences, project meetings and workshops and informal office gatherings. These observations enabled the researchers collect data related to open strategy process activities and the collaboration mechanisms used to facilitate these activities and the role played by different organisations and managers and the interaction between these organizations and managers in this open strategy process.

An abductive[2] approach was used to develop theoretical knowledge from the field data which involved systematic combining of case material with the conceptual framework through field data collected from multiple trips to the field[3] (Dubois & Gadde, 2002). This process of

[2] Traditional qualitative research takes a deductive (develop theory and taking to the field for testing) approach (Patton, 2002) or an inductive (develops theory from empirical observations) approach (Lukka & Modell, 2010) to research. An abductive approach combines these two approaches with the research taking a conceptual framework developed from theory to the field for further refinement using empirical data as the basis (Dubois & Gadde, 2002, Paton, 2002).

[3] The project commenced with an extensive review of the strategy and management control system literature and familiarisation with the Australian cotton industry. Next, familiarisation field trips were undertaken to the field

repeated collection and analysis of empirical data helped to match theory and a real world understanding of open strategy process to enable refinement and development of the conceptual framework (Dubois & Gadde, 2002, Yin, 2003).

Our study developed theoretical knowledge of an open strategy process in two stages (Paton, 2002). The first stage focused on developing an empirical grounding of the theoretical framework of open strategy processes and its key variables. The data collected from the case setting was analysed, using the conceptual model, to establish patterns to help identify linkages and connections. Based on this analysis, "thick descriptions" of the key elements of the open strategy process were developed and used to refine the conceptual model (Paton, 2002).

The second stage of the data analysis focused on developing an understanding of *how* the open strategy process operated. The explanation building was based on analytical insights and themes from the data with a focus on substantive significance which enabled refinement of emerging themes to relevant insights (Paton, 2002). This refinement was done by ensuring the data was consistent about the underlying themes, was relevant to understanding the conceptual model and was useful to develop theory (Paton, 2002). The data and analysis was used to develop an empirical representation of an open strategy process (Weick, 1989) which was then used to compare to the conceptual model of the open strategy process and this conceptual model was refined and updated to develop theoretical understanding of open strategy processes and their operation.

In the next section, we present our case findings. Following on from this section, we provide a discussion of our results and the theoretical implications of our findings.

to collect data through interviews, observations and archival document reviews and some initial analysis. This analysis helped to frame the understanding of open strategy processes and led to the development of a conceptual model. Finally, further data collection and analysis was carried out through field trips which helped to refine and further develop the conceptual framework and the development of theory on open strategy processes.

Case Findings

The Australian cotton industry

Cotton growing

Conventional cotton is a complex and risky crop to grow. It requires cotton growers to have deep agronomical and entomological knowledge to grow the crop. The challenges around growing conventional cotton centred on cotton pests and water use. Cotton pests are *Helicoverpa armigera* (also known as the cotton bollworm) and *Helicoverpa punctigera (*also known as the native budworm). These two species exist throughout the whole of the cotton season and have provided the main threat to conventional cotton crop yields. In order to manage these cotton pests, cotton growers had to carry out on average 8–12 aerial sprays on each farm in each growing season at an estimated economic cost of around $1,000 per hectare.[4] These chemical sprays also had an impact on other insects such as plant bugs and stink bugs, and also on secondary pests (e.g. two-spotted mite and cotton aphid) which grew in numbers as their natural enemies were decimated by broad spectrum insecticides.

The only valid and effective option available to combat cotton pests and diseases in conventional cotton is the use of chemical sprays. But aerial spraying cotton pests and cotton plants with chemicals created another and a far more challenging issue for cotton growers. Cotton pests developed biological resistance to these chemical sprays and as a consequence the chemicals became less effective. The development of biological resistance created a vicious cycle as chemical companies developed more potent chemicals and growers used more aggressive operational practices to spray these chemicals to control cotton pests and diseases.

Controlling biological resistance in cotton pests to chemical control measures has been a major challenge for the cotton industry. Resistance management remains a major challenge in evolutionary biology and in the agricultural sector in general. The following commentary[5] from experts in the field bears testimony to the significance of this challenge:

> I can think of few problems in evolutionary biology that are more important than controlling resistance, a problem that is serious enough now, and certain to become more so. Despite significant advances in our knowledge of the

[4] Murray, D, Cotton Pest Control in Australia Before and After Bt cotton: economic, ecologic and social aspects, Conference paper

[5] As quoted in Forrester, NW, 1993, Management of pyrethoid and endosulfan resistance in H.armigera in Australia, Bulletin of Entomological Research Supplement Series, Supplement No 1, September.

> genetics, physiology and biochemistry of resistance, little progress has been achieved in formulating practical countermeasures against the inexorable march of resistance(Prof. C.E. Taylor, 1985, Address to the Linnean Society of London).

The Pioneers

The modern cotton industry in Australia was started by three recent migrants to the country who had a passion and vision for cotton growing. The Hungarian cotton researcher, Nicholas Derera joined forces with two American cotton growers, Paul Kahl and Frank Hadley, to grow cotton in the north-west of New South Wales in the Narrabri region in a town called Wee Waa in 1961. Derera conducted pioneering research into cotton growing and breeding, showing cotton had a significant future in Australia which encouraged the American growers to relocate to Australia.

The Americans planted 60 acres in that first year. Local Australian cotton growers, such as Frank Boyle and Vic Melbourne, joined them but planted smaller amounts of cotton. The initial cotton variety used was known as the Empire variety which was sourced from Queensland. It had been used extensively in Queensland and in the Mississippi region of the US over a number of years. Derera continued to provide advice and assistance to the American pioneers. The local community in Wee Waa and surrounding towns watched the Americans and their attempts at growing cotton intensively with much interest and some concern. The first harvest day in 1962 was set up as a Field Day, open to the community and people came from all over the region to see what the "crazy Americans" had achieved and to help with the harvesting.

The American pioneers harvested around 90 bales of cotton providing a yield of around one and a half bales per acre. Compared to Californian experience, this yield was considered to be good. The harvested cotton was packed and transported to Brisbane for ginning, a process which separates the cotton lint from the seed. Paul Kahl is quoted by McHugh (1996, p10) as being cautiously pleased and highlighting three lessons: *"cotton would do well in Naomi, we had to have a gin as Brisbane was too far to haul it; and we had to have a pure seed program"*. Based on three key observations, these pioneer growers began to focus on developing solutions to these practical challenges with the assistance of cotton researchers.

Around the same time as the arrival of the pioneer cotton growers from the US, the NSW Department of Agriculture and research organizations such as the Commonwealth Scientific and Industry Research Organization (CSIRO) had developed a cotton research presence in the Naomi region in Myall Vale. The Australian Cotton Research Institute (ACRI) was set up in Myall Vale[6] to provide cotton research capabilities to support the development of the new irrigated cotton industry. Apart from Derera, other pioneer cotton researchers such as Tom Lawler, Brian Hearn and Norm Thompson played a key role in these early years to develop cotton research that was useful to support the industry. A focus of this research was on developing local Australian cotton varieties suited for the local climatic and environmental conditions, including varieties that were more resistant to cotton pests.

Key cotton organizations

Three important industry organizations were established between 1972 and 1990 which helped drive collaboration within the industry. First, Cotton Australia (CA) was established in 1972 and functioned as an advocacy and policy making organization for cotton growers. Cotton growers were organized by regions into Cotton Growing Associations (CGA) with each CGA, a member of Cotton Australia. CA was established with its own board of directors and a management team and was funded by voluntary levies paid by cotton growers. The management team was led by a chief executive officer and included regionally based staff supporting cotton growers. The CA Board was drawn from cotton growers from different CGAs. A key organizational role within the management team was the role of the Environmental Director, responsible for all environmental management issues. The role was supported by regionally based environmental staff who worked closely with cotton growers. A second organization, the Australian Cotton Growers Research Association (ACGRA), was established by cotton growers in 1972. The ACGRA was focused on strategic direction and funding of R&D. The ACGRA Constitution identified its key objectives as including the advancement and promotion of the interests of cotton growers, raising funds from members and other sources to advance the interests of ACGRA, and determining guidelines for research. It also sets out guidelines for the governance of ACGRA including membership, committee structure and procedures for meetings.

[6] In 1958, the Myall Vale Experimentation Station was established. In 1972, the CSIRO established a presence. In 1974, the Narrabri Agricultural Research Station was established.

Cotton growers served on the ACGRA Executive Committee which was its governing body, but the meetings of the committee included representatives from other firms within the industry. These representatives included managers from CA, ginning firms, merchant firms, research partner firms, cotton agribusiness consultants, seed firms, chemical firms, biotechnology firms, and government related regulatory agencies. This practice enabled the ACGRA Executive Committee meetings to provide an effective governance mechanism to enable sharing of information by managers from different parts of the industry value chain and to help in the development of new strategic opportunities. ACGRA was instrumental in providing a governance mechanism to foster industry wide collaboration.

The ACGRA's Executive Committee was chaired by innovative growers with strategic foresight who drove the development of industry related strategic issues. The first chair was Richard Williams, an American grower who is credited with the strategic development of the cotton industry in the 1970s and 1980s. He was instrumental in developing the R&D funding model for ACGRA and in driving R&D based solutions to improving cotton growing practices. He was succeeded by another innovative cotton grower, Dick Browne, who led ACGRA along a similar path in the 1990s.

The Cotton Research and Development Corporation (CRDC) was the third industry organization which was established in 1990 as a statutory corporation by the Australian government pursuant to lobbying by cotton growers and cotton researchers. The minutes of the ACGRA executive committee for the meeting held on 9 April 1990 documents the following item which supports and describes this lobbying role:

> …meeting be organised at an early date with the Minister for Primary Industries and Energy to discuss both the role of ACGRA being the responsible industry to which the new R&D Corporation would report to and also the eligibility of ACGRA members nominating as directors of the new corporation.

The CRDC is required to work closely with a lead industry representative firm for strategy and policy for cotton growers and ACGRA took on this role. ACGRA provided research direction and investment which guided the CRDC in relation to R&D project scope and investment. The CRDC is required to provide an annual report to the ACGRA on R&D projects funded and on key findings from these projects and the basis for turning these

findings into information and technologies that could be used by cotton growers to improve their operational activities. This practice ensures that managers from these firms collaborate, share information and knowledge, and develop common strategic approaches. The minutes of the ACGRA executive committee meeting held on 6 February 1992 documents the inaugural reporting by the CRDC Chair to the ACGRA. The report covered the strategy and operations of the CRDC in its first year of operation and included information on R&D projects funded and outcomes from these projects.

Finally, the Cotton CRC was a specialist research firm established and funded by the Australian government with a focus on applied research in the cotton industry. The Cotton CRC was first established in 1993 and was in existence until 2012. The Cotton CRC was mandated by the Australian Government to operate as a collaborative research partner firm on a seven year cycle, with extensions provided at the end of this seven year period. Two extensions to the CRC were granted by the Australian Government.

The CRC mission is described as providing high quality collaborative research, education and adoption activities which benefit the Australian cotton industry, regional communities and the nation. The purpose of the CRC is described as facilitating the delivery of a cotton industry that adopts world best practice in production, environmental and catchment management; secures international competitiveness using research to increase yield and fibre quality; and generates improved social and economic conditions in cotton communities.

The CRC operated on a collaborative partnership model which included 11 core partners and 36 affiliate partners. Core partners included Cotton Australia, CRDC, CSIRO, private companies (e.g. cotton seed distributors), and several universities. Core partners provided research expertise, funding and resources to further the research agenda of the CRC.

> The key functions of CRC to fulfil have been the role of collaborator and facilitator for the multiple organisations and actually having the Commonwealth agreements with which state what you're going to achieve as a collective. It really drives collaboration, drives that communication. So it is akin to very much the mortar and the brickwork, so you've got the large bricks obviously being Cotton Research Development Corporation, your university partners, CSIRO, the state agencies, Cotton Seed Distributors (CSD), they're the bricks and they provide the mortar which goes between and it's a

> commonality of a focus in pulling it together. The ability to talk to another institution or organisation under the umbrella of the CRC – it's not one organisation talking to another organisation and there's no connection between them. That's the bridge that operates between them. (Senior Executive, CRC)

The CRC conducted its research, development and extension programme through five streams. Each stream was managed by a CRC manager and involved program managers from key partner agencies. Research projects in each stream were conducted by research partners with funding from the CRC, CRDC and partners. The five research streams were: Farm, Catchment, Community, Product and Adoption.

Other stakeholders in the cotton industry

The Australian cotton industry includes a range of different individuals who have played a key role in the open strategy processes within the industry. These individuals include cotton growers, cotton consultants and cotton researchers. These individuals are closely involved and aligned with the key industry firms discussed in the prior section and brief commentary is provided here on each group for completeness.

There are around 1,500 individual cotton growers who operate through around 800 cotton farms in the Australian cotton industry. Cotton growers can operate within the industry in a range of formats. These include tenant farmers who lease a small cotton farm, family owned cotton farms and large corporate farms. Typically, cotton growers are irrigation agriculturalists who also grow other crops such as sorghum and also cattle.

Cotton growers are located in two main regions in Australia: in North-West New South Wales around the Narrabri region and in South-East Queensland in the St George and Toowoomba regions. Growers are organized by regions into Cotton Growing Associations (CGA) which hold membership in Cotton Australia. These CGAs also nominate individual growers to serve on the CA Board and other governance committees and generally encourage their participation in industry activities.

The second group of stakeholders are cotton consultants. These consultants are private business operators with an agricultural science and business background who provide advice to cotton growers on a range of matters related to cotton growing including agronomy, water and pest management and fibre quality. These consultants in some instances have operated as cotton growers and have solid farming experience. They have played an influential role in

identifying strategic challenges across the industry, particularly in relation cotton pests and their management, and in helping other groups of stakeholders and industry firms to develop solutions to these issues.

Cotton researchers are important stakeholders in the Australian cotton industry. These researchers are employed by the research organizations such as the CSIRO, universities and state governments but are contracted by cotton industry firms such as the CRDC and CRC to engage in research and development projects to develop new information on issues such as managing cotton pests, improving cotton cultivars and developing better farming practices around water and land management. The economic and environmental performance improvements in the cotton industry in the past fifty years have benefited significantly by research work and outputs from this group of researchers who have worked collaboratively with cotton growers and cotton consultants to manage the strategic challenges faced by the industry.

Cotton growers and organizations- interdependencies

Cotton organizations and stakeholder groups (eg: cotton growers and researchers) developed a network of interdependencies through a range of mechanisms which helped the industry grow and manage the strategic challenges faced by the industry.

Administrative governance mechanisms (Malmi & Brown, 2008) have been established and used creatively by the cotton industry. An important governance mechanism used in the industry is the bi-annual Australian cotton conference. Since 1969, the ACGRA had organized bi-annual cotton research conferences which provided a useful forum for cotton growers, cotton researchers and other industry managers to collaborate, share information from research projects, provide feedback on the usefulness of research outcomes, and identify new strategic issues and approaches.

A special sub-committee of growers from the ACGRA Executive Committee were given responsibility for organizing the cotton research conferences including developing the conference agenda, identifying relevant conference presenters, deciding on conference venues, accommodation, entertainment and pricing. The conference agenda provided the key mechanism for interaction between different groups of managers from the industry. A research project carried out by the Cotton CRC documents the role of these conferences and how they have enabled collaboration between researchers and growers:

> Cotton conferences in Australia have been an instrument used to overcome geographical and social challenges by bringing communities together, sharing ideas and research, and uniting growers. Conferences became a showcase for local research and became a key resource for both early adopters and prospective growers. It was also used to address industry-wide matters. (A historical geography of cotton farming in NSW and QLD: adaptation and adoption, p15).

The formation of the conference agenda was a collaborative activity between ACGRA and other industry firms such as Cotton Australia and the CRDC. The conference agenda showcased R&D projects carried out by cotton researchers on a range of topics relevant to the industry and cotton growers. As cotton researchers presented these research projects – including the scope of the work, key research questions, methods used and findings – managers from different industry firms, including cotton growers, were able to assess the practical value of the research findings, discuss their translation into grower operational practices, and understand the mediums to be used for this translation (e.g. new technology, best practice information). provides an extract from the 1996 conference agenda which describes a range of R&D projects relevant to the development of transgenic cotton and improved IPM practices.

Table 1 Extract of 1996 Cotton Research Conference Agenda

- Resistance management-a key to the transgenic era
- Refuges: a key element in transgenic cotton management
- Qualifying the value of refuges for resistance management of transgenic Bt Cotton
- Will current secondary pests become a problem
- Using predators and parasites to control cotton pests
- Alternative crops for producing natural enemies of cotton pests
- The potential for transgenic cotton plants to select for resistance in *Helicoverpa armigera*
- Arming cotton plants with an insect virus to beat the Bollworm
- Environmental risk assessment of GM insect viruses for the control of *Helicoverpa* species

Industry-level committees were another governance mechanism which provided a forum for enabling inter-dependence within the cotton industry. An eminent example of an industry-level committee was the Transgenic and Insect Management Strategy (TIMS) committee. TIMS was formed as the premier committee of the ACGRA to manage the development and implementation of a management strategy for the introduction and growing of transgenic

cotton. This management strategy included the development of a resistance management strategy. Three key strategic objectives were established for TIMS:

1. To design a management strategy which will preserve current and future insect management systems
2. To correct/change the insect resistance management strategy in accordance with conditions such as chemical shortages or exceptional Heliothis problems
3. To "police" and monitor the application of the strategy and provide clearance for deviations or major changes to the strategy

The committee membership provided an example of industry wide collaboration with five cotton growers from ACGRA, three cotton researchers, one representative from Monsanto, two representatives from CSD, one representative from the Queensland Department of Primary Industry, one cotton consultant and one representative of a chemical company. The committee was chaired by a cotton grower from ACGRA. The focus of TIMS from the start was on collaborative action to enable the emergence of transgenic cotton:

> It took a couple of meetings convened by ACGRA and the organisational membership of the committee was determined and what its scope would be and what it would do and off it went…That was a pretty big thing for the industry to do but it needed broad support. So that's where the kind of industry committee evolved, so it wasn't Cotton Australia or CRDC telling everyone what to do, it was broad - so the committee tries to operate through negotiated consensus (CC1).

A key administrative mechanism has been four Research panels[7] which have provided a platform for cotton growers, cotton researchers and managers from Cotton Australia and the CRDC to discuss research direction and signal R&D project approvals to the CRDC board of directors. Each Research panel is facilitated by a Cotton Australia manager. Panel membership is restricted to cotton growers who are drawn from different CGAs to provide a broad representation of the cotton grower population. CRDC program managers with responsibility for relevant strategic themes and R&D investments related to this theme attend and provide advice. The panel members review each R&D project proposal put forward by the CRDC and provide assessments and reviews of the project and its relevance for cotton

[7] farming systems, value chain, human capacity, and biotechnology.

growers. The panel chair provides a formal summary of R&D projects approved by the panel to the Annual General Meeting of Cotton Australia which is attended by all cotton growers. The CRDC program manager takes back the advice from the panel to the CRDC to inform their recommendations on R&D investments which are provided to the CRDC Board of Directors.

Development of a culture of collaboration

Cultural systems (Malmi & Brown, 2008) were used innovatively by stakeholders within the cotton industry. Organizational values, symbols and clans were used creatively by these stakeholders to build a common focus and to encourage cooperation between different organizations in carrying out open strategy processes.

A core group of cotton growers and cotton researchers including the pioneers provided impetus to the development of a "culture of collaboration" within the industry. The newness of the industry, the lack of established cotton growing practices and the presence of migrant growers and researchers from overseas contributed to the development of this collaborative partnership. The challenges of managing cotton pests added to the urgency for this collaboration. One cotton consultant from Narrabri, NSW described the role and influence of this early group of pioneer growers:

> I think some of the early leaders in the industry basically identified that the only way that they could make progress was to work together. So there was that collaborative aspect right from the outset. (CC2)

Key industry organizations and their managers were enlisted by the pioneer leaders to act as champions to help foster, develop and spread these common values to establish the culture of collaborative partnerships. One cotton consultant describes how the focus on this common value provided the rationale for collaborative partnerships: "*we have to try and act as a collective regardless of what individuals think…. We essentially have to reach for that common value as the rationale for what we're involved in and why we're involved in it"* (CC1).

The pioneer growers focused the development of the common culture and values on a strategic tool that could help the industry develop solutions that could be implemented to improve grower operational activities. They realised that knowledge and information on managing industry challenges in relation to cotton pests and diseases was unavailable; they

also recognised that unless this knowledge and information was developed and turned into practical outcomes, grower operational activities would not improve – this helped to focus attention on R&D. One cotton consultant, a son of one of these pioneer cotton growers, described how his father was committed to the value of research and helped to foster this belief in other managers involved in the cotton industry: *"my father was just absolutely committed to the value of research and the importance of research and it could have been just the fact that there was enough people around that saw that it was important enough to invest voluntarily in to make the industry work"* (CC3).

The research based culture was jointly developed by cotton growers and cotton researchers who developed R&D projects which were identified as relevant to the production of knowledge and information that could be used to help develop improved grower operational activities. The success of these projects in producing useful and practical knowledge, adopted by growers and used to improve their operational activities, helped to cement the research based culture in the cotton industry.

The development of a common culture and values has been fostered by the co-location of cotton researchers from different disciplines and research partner firms in one physical location. This co-location helped to break down barriers to communication and collaboration by enabling these different types of researchers to interact. From the commencement of the modern cotton industry in the 1960s, cotton researchers have been based at the Australian Cotton Research Institute (ACRI) in Myall Vale, just outside Narrabri, NSW. Occupying the same physical space has helped to develop networks and connections between different cotton researchers and has helped them overcome organizational and discipline barriers to work collaboratively to research and develop knowledge that has practical value for cotton growers.

The locating of cotton researchers in the cotton growing region of Narrabri, NSW helped to develop close networks and connections between grower and researcher. Researchers were able to visit cotton farms and examine grower issues and challenges first hand and share their research outputs; developing common outcomes that helped growers improve their operating activities. One cotton consultant who has observed the operation of these networks described how growers and researchers used these networks to develop useful and practical research outcomes:

> So with those real successes but also charismatic is probably too strong a word but we were blessed by researchers that didn't just sit at the research station and do their research and publish papers…. These were guys that went out into the fields and spoke to farmers, got feedback from farmers but also told their story to farmers. There was always very much a working relationship, certainly a core of the really respected researchers rather than being in this ivory tower that gave information down from on high…. they have these relationships with growers where growers will just ring them direct and say, I've got this kind of bug, what is it or how do I manage it or whatever… The industry was also very blessed in having some very, very good researchers at both entomology and plant breeding (CC3).

Strategic uncertainties

Serious ecological issues thrust the Australian cotton industry into the public consciousness in 1998 with a series of incidents that threatened its economic and environmental viability. The Sydney Morning Herald (SMH), a Sydney based national newspaper ran a story with the headline *"Cotton chemicals found in Export Beef"*.

> The Queensland Government has been accused of covering up a meat contamination scare after news emerged yesterday that cattle from 10 properties have been rejected at export abattoirs in the past week. The northern NSW and southern Queensland produce tested positive for endosulfan, the main chemical spray for the cotton industry, which today launches its $1.5 million "good neighbour" policy. Several samples had levels of endosulfan higher than the maximum allowable of 0.2 mg/kg, sparking a week of high tension between the beef and cotton industries. Mr Justin Toohey, the Cattle Council of Australia's director, said producers were unhappy with the cotton industry. "This is a Christmas present the industry doesn't really need," he said. Mr Digby Cooper, a grazier from St George in western Queensland, said pastures on his property had returned endosulfan levels up to 0.75 mg/kg, while four cows tested recorded levels of up to 0.36 mg/kg.

The headline of the related news story which appeared the next day, 19 December 1998, in the SMH was even more serious for the cotton industry: *"Growers Need to be Greener, Says*

Vaile". Quoting the Australian Agriculture Minister at the time, the article recorded the Minister issuing a blunt challenge to the cotton industry to *"improve its environmental practices"*. Minister Vaile is quoted as saying: *"unless we are squeaky clean, we won't sell our cotton, we won't sell our beef, we won't sell our wheat, we won't sell our dairy products"*.

The failure of Pyrethoid chemicals

From the commencement of the modern cotton industry, cotton pests posed a serious challenge and required large amounts of pesticides which increasingly failed to protect cotton plants from the ravages of the cotton pest. The issues relating to cotton pests and resistance came to a head in the 1983/84 cotton growing season when Pyrethroid chemical sprays failed to provide satisfactory field control of *H.armigera* (cotton Bollworm) at Emerald, Queensland. Since the late 1970s, Pyrethroids had been considered miracle insecticides and had many redeeming features which favoured their use by cotton growers: they were regarded as cost effective, were required in low dosages, had no residue problems, were safe to mammals, had low environmental impact, and were immobile in the soil. By 1986, Pyrethroids represented 25 per cent of all insecticides used in agriculture and public health and 49 per cent of insecticides used in cotton (McHugh, 1996). They were well regarded in cotton farms due to their effectiveness against most cotton pests. The breakdown in Emerald showed for the first time that cotton pests had developed resistance to Pyrethroids. A research scientist with a research partner organization described the advent of resistance in this period-

> The *Helicoverpa,* which had developed resistance to DDT, developed resistance to the next generation of … synthetic pyrethroids. When the synthetic pyrethroids came in, in the late '70s, we told the industry very clearly, if you use these the same way that you used DDT, you will have resistance…… When resistance finally came in about '83, I think that was a turning point. (Research Scientist)

The failure of Pyrethroid chemical sprays to control cotton pests forced the industry to consider improving operational activities. The focus of these improved activities was on reducing the reliance on insecticides and chemical sprays, and developing a more holistic approach to pest management that used a range of measures. These improved operational activities included the use of biological control measures, such as the use of beneficial insects to prey on cotton pests, and activities to manage the spread of chemicals from the farm to the

natural environment around the cotton farm. The use of transgenic cotton varieties was also identified as an improved operational activity, but these varieties were yet to be available commercially.

The challenges posed by cotton pests and diseases and the related but significant issue of resistance forced cotton growers to rethink their operational activities. Cotton Australia, as the key strategy and policy firm for growers, became focused on developing a strategy to "reinvent" the industry to allow the industry to *"shoulder the economic, moral and legal responsibilities of adulthood"* (Executive Director, CA, Strategy Document, August 1990).

Managing strategic uncertainties-open strategy process

Cotton pests posed a common strategic challenge to all cotton growers and cotton organizations in the industry. There was growing pressure on the cotton industry from a regular stream of "environmental incidents" related to the use of cotton pesticides to manage cotton pests. Community concerns about cotton growing operational practices were increasing pressure on the Australian Government to regulate the industry. The environmental movement was in favour of increased government regulation of industries which had harmful operational practices and the cotton industry was a particular target:

> The resolute, articulate and well-organised environmental movement is a definite threat to our industry. In the long-term, it may also prove to be one of our greater opportunities. Cotton Australia is charged with the responsibility of undoing many years of neglect and public ignorance about this industry. Our biggest and most testing challenge is to ensure the industry is not regulated out of existence. (Executive Director, CA)

However, there was also acknowledgement by these managers that they lacked knowledge and information on the specific impacts of chemicals on the environment and how chemicals ended up in regions outside cotton farms including riverine systems. There was wide acknowledgement that changes to operational practices had to be grounded in research based knowledge and information that helped to design improved practices. This knowledge and information had to be assessed, developed and translated into best practice with the involvement of cotton growers. The Environmental Director of Cotton Australia described this strategic approach in the 1992 Annual Report (p 5):

> Cotton's response to mounting pressure in the late 1980s and early 1990s was to commission the now historical Environmental Audit in 1991. Addressing its findings…..provides a focus for solid foundation for best practice. The means by which the cotton industry will steer itself through the increasing political and environmental pressures is by adhering strictly to an industry code of practice or best practice guidelines.

A range of measures were put into place to meet this strategic challenge of improving cotton operational practices.

First, planning systems (Malmi & Brown, 2008) were used to develop strategies that provided a common focus for stakeholders to identify and manage the strategic challenges posed by the cotton pest. As the industry's representative organization for cotton growers, Cotton Australia developed and published the first formal strategy for cotton growers in the Australian cotton industry. The purpose and focus of this "industry strategy" was to provide a strategic focus for cotton growers, consultants and researchers by elevating the importance of achieving important strategic objectives and to also highlight the gap between these strategic objectives and current operational activities.

The strategy provided a focus on ambitious competitive strategic objectives which focused on environmental management and economic management issues. The role of the strategy was to provide a basis for cotton growers and other managers, such as cotton researchers and cotton agribusiness consultants, to consider how to develop information and technologies to design "best practice" operational activities which could be used to implement actions to meet these strategic objectives at the firm-level. At the time of their development, these strategic objectives were not achievable as the industry had not developed this new information and technologies.

The strategy document[8] prepared stated the mission in the following terms:

> To be the key industry forum, ensuring the viable growth and development of the Australian Cotton growing and processing industries.

The environmental management objective was described as to:

[8] CA Strategy Document, August 1990

> Foster, educate and influence growers, consultants, aerial operators, processors, chemical manufacturers, farm input suppliers and other industry organizations and partners in responsible practices in land care, chemical and water use, and in other related practices that support and maintain a sustainable base for cotton growing. (Cotton Australia Strategy Document, Aug 1990)

The economic objective was described broadly as to:

> Create a positive profile of the Australian cotton industry as reliable producers of high quality product, as a major Australian agricultural export industry earning in excess of A$ 750m export revenue, and as a valuable natural fibre in the domestic fashion, homewares and industrial sectors. (Cotton Australia Strategy Document, Aug 1990)

The Cotton Australia strategy provided a basis for cotton growers and related managers to focus on developing new information and technologies to improve cotton growing operational activities and to achieve these strategic objectives by using information and technologies at the firm-level.

Second, measurement systems (Malmi & Brown, 2008) were introduced and used to assess current performance, to identify performance gaps and to develop approaches to close these gaps. In order to understand the impact of current operational practices and activities, Cotton Australia commissioned an Environmental Audit which was carried out in 1991. The audit was undertaken by two external consulting organizations: Arbour International and Gibb Environmental Sciences. The environmental audit, the first of its kind in the agricultural sector anywhere in the world, had as its overall aim the *"identification of major environmental issues relating to the Australian cotton industry and to assess the overall performance of the industry with respect to these issues"*.[9] The scope of the audit was to investigate the *"environmental impacts of cotton production from the establishment of new cotton farms to the production of ginned, raw cotton"*.[10] The range of activities investigated were those engaged in by members (i.e. growers) of Cotton Australia. The *1991 Environmental Audit Report* provided 69 key recommendations. The recommendations

[9] Gibb Environmental Sciences and Arbour International, 1991, An Environmental Audit of the Australian Cotton Industry, p1

[10] Gibb Environmental Sciences and Arbour International, 1991, An Environmental Audit of the Australian Cotton Industry, p2

covered a range of areas: Pesticide use (31 recommendations); Land use (7 recommendations); Water use (11 recommendations); Cotton processing (20 recommendations). The pesticide recommendations covered a range of operational activities and suggested improvements. Cotton Australia managers provided an initial response to each of the 69 recommendations in an Action plan.

Third, there was a need to understand and integrate current research knowledge of the impacts of grower practices, particularly in relation to pesticides and the environment. A research study was commissioned which provided a detailed review of current knowledge of the impact of cotton pesticide use on rivers and the biodiversity within these rivers. The topics covered included water management issues on the farm, pesticide use issues covering the chemical structures and lifecycles, the regulatory environment covering the rivers in New South Wales and Queensland, industry attitudes, fate and impact of pesticides in river waters, and current research into pesticide impacts on rivers and biodiversity.

The stocktake of current knowledge and identified gaps and the findings of the environmental audit provided the basis for managers in industry firms to collaborate to determine research priorities. A workshop was held in the NSW town of Goondiwindi in May 1992 where managers from Cotton Australia, ACGRA, CRDC, Cotton Consultants Association and other stakeholders came together to review the state of knowledge on the use of pesticides and their impact, and to provide an approach to developing knowledge on practice improvements that were needed.

Based on the discussions at the Goondiwindi workshop and ongoing interactions between managers from various industry firms, a major R&D programme was formalised in 1993 as a partnership between three key industry firms: the CRDC, the Land and Water Resources Research and Development Corporation (LWRRDC), and the Murray Darling Basin Commission (MDBC). The R&D programme was formally named *Minimising the Impact of Pesticides on the Riverine Environment* (The Program) and was conducted for a period of five years to 1998.

The Program is representative of the strategic use of R&D by the cotton industry to manage the external environmental threats posed by the cotton pest which affected all cotton organizations. The Australian cotton industry has been a proactive investor in R&D to innovate and develop new technologies, information and practices, to facilitate the

development of a world class global industry with sound environmental and economic credentials. Led by the pioneer cotton growers who helped establish the modern industry, R&D has been used as a strategic tool to improve the business performance of the industry. The cotton growers and cotton researchers within the industry understood the importance of R&D and developed mechanisms to ensure investment in R&D was organized in a way that enabled growers and the Australian taxpayers to share the responsibility for investment. There are two aspects to the investments made by cotton growers in R&D: investment of capital and providing research direction.

First, through the ACGRA, cotton growers put in place a mechanism for R&D capital investments by all growers. A voluntary levy was established that each grower was required to contribute towards an R&D investment pool which was managed on behalf of all growers by the CRDC. This levy was linked to the market price earned by growers on each bale of cotton and was collected from revenues earned once the bale was ginned and sold to cotton merchants. The levy was collected and invested in the R&D investment pool, initially by the ACGRA and later by the cotton merchants who paid the net market price to the cotton grower. The inaugural R&D voluntary levy (from around 1972) was set at 25 cents per cotton bale. The voluntary levy was raised to $2 per bale in 2000 and is now at $2.25 per bale.

The R&D capital investment funds provided by cotton growers were matched by the Australian Government. The Australian Government has developed an approach to funding agricultural sectors through Rural Research and Development Corporations which have been established to fund R&D in each of the major agricultural sectors such as cotton, cattle and beef, grains and horticulture. These research and development corporations are established by Australian Government legislation with a mandate to direct research funding to R&D projects to develop and improve technologies and practices in these industries. In the cotton industry, the CRDC has replaced the Cotton Research Council which was the precursor firm providing and managing research funding within the industry. Around 0.5% of the gross value of cotton at the farm gate is invested by the Australian taxpayer in cotton research. The CRDC also earns royalties from new technologies developed and patented which are reinvested in the R&D pool to fund R&D.

Second, cotton growers have also invested in R&D by providing research direction to enable appropriate scoping and conduct of R&D projects which have provided new technologies, information and practices. Initially, this research direction was provided by the Executive

Committee of the ACGRA. The ACGRA Executive Committee sourced, funded and managed R&D projects to identify how grower activities were impacting on the environment and on their economic productivity.

The first task was to identify issues that needed to be researched. This task was carried out by industry sub-committees established by the ACGRA Executive Committee. These sub-committees covered a range of relevant cotton growing topics including entomology, soils and tillage, agronomy, plant breeding, genetic engineering and marketing. Each sub-committee comprised of grower members with a chair who provided a reporting line to the Executive Committee. The sub-committee was responsible for identifying key issues in their portfolio area which required R&D. This information was provided to the Cotton Research Council which was responsible for coordinating the scoping and funding of R&D projects.

The second task was for the Executive Committee to review R&D projects which had been submitted to the Cotton Research Council. As an example, the ACGRA Executive meeting on 12 April 1988 considered 32 continuing R&D projects to the value of $1.2m and 43 new projects to the value of $1.5m (see Table 4.2). These amounts were considered substantial investment of funds at the time.

Table ACGRA R&D projects

R&D project type	Continuing projects	New projects
Cotton plant	$0.2m	$0.1m
Cotton crop	$0.3m	$0.3m
Insect pests	$0.4m	$0.7m
Cotton diseases/Weeds	$0.1m	$0.1m
Crop management systems	$0.2m	$0.2m
Communications/transport		$0.1m
Total	**$1.2m**	**$1.5m**

Source: Minutes of ACGRA executive committee, 12 April 1988

The Executive Committee made recommendations on each R&D project to the Cotton Research Council. These R&D projects played a monitoring role in helping cotton growers assess their current operational activities, particularly in relation to chemical use to control cotton pests. The R&D projects assessed the natural environment and riverine systems for chemical pollution and helped to identify the pathways used for the transport of the chemicals

from the cotton farm. Other R&D projects examined new operational activities that could help to better protect cotton plants from cotton pests and diseases without creating the adverse impacts on the environment and the high economic costs of chemical use.

The ACGRA Executive Committee provided a platform for cotton growers, cotton researchers, cotton agribusiness consultants, and other managers of firms within the Australian cotton industry, to collaborate to scope and carry out R&D projects that were focused on key strategic issues faced by the industry. Key strategic issues such as developing improved cotton varieties which were resistant to cotton pests, new technologies, and "best practice" information to improve cotton growing operational activities, provided the basis for these R&D projects.

Transgenic cotton and Integrated Pest Management Practices (IPM)

The focus of R&D programmes during this period was on developing improved cotton cultivars and cotton operational practices which could enable cotton growers better manage the strategic challenges posed by the cotton pest. There was a growing realisation that the best and more effective solution for managing resistance in cotton pests and reducing the harmful effects of chemical control measures was to move to non-conventional cotton and to adopt integrated pest management (IPM) practices that took a holistic approach to managing resistance.

Biotechnology organizations such as Monsanto had been researching the development of non-conventional or transgenic cotton varieties since the late 1980s. These transgenic cotton varieties were aimed at providing biological control of the main cotton pest varieties- *Helicoverpa armigera and Helicoverpa punctigera*. The first generation of transgenic cotton produced by Monsanto was branded as Ingard cotton and included a gene called Bt (i.e. *Bacillus thuringiensis*). This bacterium produces a protein which controls certain Lepidopteran larvae (caterpillars) when they feed. The Ingard cotton has a gene which produces the same protein and provides similar outcomes. The Bt bacterium are microscopic, single-celled organisms which are found in large numbers in any soil sample anywhere in the world. A teaspoon of soil could hold millions of Bt. More than 20,000 different Bt strains have been isolated by scientists from soil samples.

The availability of transgenic cotton varieties has also helped cotton growers adopt integrated pest management (IPM[11]) practices more effectively. IPM represents a collection of "best practice" cotton growing practices[12] that improve growers' individual operational activities in relation to managing cotton pests and diseases. IPM is based on a thorough understanding of the ecology of pest and beneficial species and their interaction with the crop, and provides growers with a range of strategic activities which must be integrated to achieve economic and environmental sustainability.

The new strategic approaches, transgenic cotton and IPM, were being developed and tested in this period and there was a growing awareness amongst key industry managers that these approaches could help manage industry-level ecological issues relating to cotton pests. But the practical adoption and application of these strategic approaches to influence grower operational practices had not as yet materialised. The planning for the implementation of these new measures began to occur from 1992 as cotton growers and cotton researchers grappled with the key strategic challenges posed by the cotton pest.

The Cotton Research Conference held in 1992 provided the first opportunity for interaction between cotton researchers and growers and other industry managers on the topic of transgenic cotton. At the conference, a Forum on Managing Biotechnology was held and chaired by Dr Gary Fitt from CSIRO who had been the leading researcher on the development of transgenic cotton varieties in the cotton industry in Australia. The purpose of the Forum was to brief growers and other industry managers on the evolving search for improved practices for managing ecological issues related to cotton pests and diseases, and to encourage greater engagement of growers in this search. As described by Dr Fitt:

> The Australian cotton industry relies heavily on chemical pesticides for management of a diverse array of pest insects, weeds and diseases. Pesticide use is a major economic and environmental liability for the industry and all measures to reduce this dependence need to be taken…(Gary Fitt, CSIRO, 1992 Cotton Conference proceedings, p387)

[11] "careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms" (Food and Agriculture Organization, 2002)

[12] These practices are based on a range of principles including the use of best practice crop agronomy, effective sampling for pests and the use of thresholds, conservation of beneficial pests, use of trap crops and communication and sharing of information on these practices with growers

Best Management Practices (BMP)

Procedures and policies (Malmi & Brown, 2008) provide a basis for regulation and bounding of operational practices and also serve to influence these practices at the organizational level. At an industry level, these procedures and policies can help to spread "best practices" developed through R&D projects.

The information on new and improved cotton growing practices, such as the use of transgenic cotton and IPM which were developed through R&D projects conducted through The Program and similar research programmes, required a mechanism to enable its wide diffusion to cotton growers. This mechanism would provide the basis for individual cotton growers to access the information and to be able develop and implement strategy that enabled achievement of improved environmental and economic performance for firms and the industry.

A BMP based approach was chosen by cotton growers and their leaders as it was thought to provide a *"process for benchmarking and where necessary methodical and rational change in management systems and a basis for cultural change"* (Senior Cotton Grower, Pesticide conference address, 1998). This approach was recommended by external consultants who reviewed the work undertaken by industry R&D programmes:

> Emphasis should be shifted to supporting Phase 2 of the research program, i.e. to identify and test potential methods for ameliorating problems by supporting proposals for…..development of a comprehensive Best Management Research Project……a Best Management Practices Manual should be developed for use by growers and consultants. (CR Harris, University of Guelph, Ontario, Canada, Independent Program Review, Jan 1996, p4)

The use and adoption of practices in the BMP system involved a number of stages. First, growers were required to conduct a self-assessment of their individual operational activities in each of the four categories of BMP. Self-assessment worksheets with a series of questions were included for each category of best practices which allowed the grower to assess their operational practices, identify issues and risks. The use of risk ratings (from 1-low risk to 4-extreme risk) allowed the grower to identify high priority areas within their operational activities which required action plans to enable improvements to be made.

Second, for critical issues identified in high risk (3-4 rating) categories, the BMP Manual provided another framework for more detailed farm plans. This framework took the form of hazard identification and analysis and lead to a specific set of best management practices (BMP) tailored for a farm. This framework provides specific actions that can be taken incrementally by the grower to improve his operational practices. The framework focuses on a *"list of activities which occur on a cotton farm and then the hazards associated with these activities and for which best management practices will be developed and applied"* (CC3, Pesticide conference presentation, 1998). Rather than design a prescriptive set of practices, the grower is able to develop *"their own best management practices and to check them against some standard issues included in the Manual… [This process] alerts people to key issues and potential problems while allowing them to develop a set of practices with accompanying monitoring systems which suit their specific circumstances and operations"* (CC3-Pesticide conference presentation, 1998).

The final stage involved the development of actions plans to manage areas identified as high risk (3-4 rating). The solutions, monitoring and review processes to assess if the chosen solution is effective, and the person responsible for the action plan, are all identified in the action plan. To help growers develop action plans, best practice booklets on specific topics and other material are also included in the manual.

The system provides a flexible framework for managing and improving cotton grower operational activities, recognising the varying environmental, commercial and social conditions faced by cotton growers. The planning framework helps to build flexibility while allowing growers to minimise any negative impacts from their operational activities and helping to demonstrate their commitment to responsible resource management.

Mutual dependence and limited power imbalances

Cotton pests provided a common external threat that impacted all cotton growers and cotton organizations. The operational practices available to cotton growers, prior to the availability of transgenic cotton which was more resistant to these cotton pests and improved IPM, were focused on pumping out increased amounts of pesticides which decimated not only the cotton pests but the surrounding ecosystems and poisoned the waterways around cotton farms creating environmental damage on a large scale. The effectiveness of pesticides was reduced

by the development biological resistance by cotton pests to the chemicals used in the pesticides.

The existence of a common threat that impacted all cotton growers in a similar manner created a mutual dependency amongst cotton growers and cotton organizations. This mutual dependency created a situation where there was a low level of power imbalance between cotton growers and cotton organizations. All cotton growers were faced with the same cotton pest. All cotton growers had very similar operational practices which may have been executed differently but produced similar results. Other stakeholders such as cotton researchers were developing improved knowledge that would eventually be coded into improved "best management practices" but were dependent on cotton growers for testing and developing this knowledge and for funding their research projects. Power imbalances were low and all stakeholders were mutually dependent within this industry.

Analysis and Discussion

Our study had two aims. We have analysed our case findings in relation to these two aims.

Why do organizations engage in open strategy process?

Resource dependence theory provides important theoretical concepts which are useful to help us understand the incentives for organizations to collaborate and engage in open strategy processes. Organizations are dependent on other organizations for resources and support (Casciaro & Piskorski, 2005, Pfeffer & Salancik, 1978). When resources and support are constrained, organizations have incentives to absorb or eliminate these constraints through mergers and acquisitions, joint ventures and other forms of inter-organizational relationships (Hillman et al, 2009).

When the resource constraint is due to a strategic uncertainty not controlled by any single organization and has a similar impact on multiple organizations, the absorption or elimination of this resource constraint becomes problematic. The traditional constraint absorption or elimination approaches such as mergers and acquisition, joint ventures and other forms of inter-organizational relationships become inadequate as all organizations face the same constraint and are unable to control or manage it. Organizations become mutually dependent and have incentives to engage in collaborative strategic activities to manage the resource

constraints. Open strategy processes are a new approach which helps these organizations to manage this externally-induced resource constraint.

In our case, ecological issues created a strategic uncertainty which was not under the control of any single organization within the industry. These ecological issues had similar impacts on each of the organizations within the industry. Each of these organizations was constrained as their resources were inadequate to manage these ecological issues. The operational practices of all grower organizations had to be improved and changed to meet these challenges. Information to improve and change these practices had to be developed through R&D projects. Therefore, the ecological challenges generated a resource constraint which forced the organizations in the industry to become mutually dependent and to share resources to develop new information. These organizations had incentive to engage in open strategy processes.

Role of MCS in open strategy processes

Caglio & Ditillo (2008) identified three control problems that need to be managed in inter-organizational relationships: cooperation, coordination and resource appropriation. These three control problems are particularly important and challenging in an inter-organizational collaboration where multiple organizations are mutually dependent and there exists a necessity for fair resource appropriation to manage the external threats which is not controlled by any one organization. Management control systems are used *within* organizations to enable cooperation, coordination and resource appropriation and can be used to perform these functions between organizations in an open strategy process (Flamholtz, 1996, Malmi & Brown, 2008). Our case findings demonstrate how these systems were used as industry-level control mechanisms in an open strategy process.

Cooperation between organizations engaged in the open strategy process is important to ensure that all participants share resources equitably, coordinate strategic activities and share equally in the benefits arising from the process (Caglio & Ditillo, 2008). Cultural systems (Malmi & Brown, 2008) consisting of organizational values, symbols (eg: co-location of organizations and managers) and clans (eg: professional groups of managers) help to enable cooperation by establishing shared values and culture which influence behaviour and actions. Shared values and beliefs provide direction and purpose, are communicated through vision and mission statements and influence the operational practices of managers. Our case

findings explain how shared values influenced operational practices of managers in the industry. Symbols-based systems include co-location of managers from different organizations in the same physical locations which helped to visibly signal to managers the shared values and culture expected of them. The co-location enabled managers from different organizations to communicate more freely and share ideas to maintain a strategic dialogue. Professional groups of managers, organized along functional specialities, operate as clans which have values and beliefs which are aligned to broader belief systems. Through co-location, these professional groups of managers are able to share information and ideas and to maintain a strategic dialogue.

Inter-organizational collaborations require good coordination of strategic activities (Caglio & Ditillo, 2008). Coordination is enabled by administrative structures and governance mechanisms (Malmi & Brown, 2008) which provide a platform for managers and organizations to meet, share information, discuss problems and challenges and to develop approaches to resolve these problems and challenges. Our case findings demonstrate how these systems were used.

Industry organizations (eg: Cotton Australia) have two played important roles in coordinating strategic activities. First, these industry organizations have enabled functional specialisation. These industry organizations provided a platform for the distribution of the strategic information developed through the open strategy process, to individual organizations within the industry. The second important role of industry organizations is the networks and relationships that they enable and develop. Each industry organization is able to draw into its fold individual organizations and managers, through shared membership or through other means of involvement such as secondments, and enables these managers to develop networks and relationships outside their own organizational boundary.

Governance mechanisms (eg: meetings, committees) operated as industry-level coordination mechanisms in two important ways. First, these mechanisms enabled formal and informal lines of authority and accountability through the organizational role of the chairperson and through a shared agenda. Having a respected industry manager in this role also enabled this to be a key management control mechanism *between* organizations as this industry manager is able to attract other important managers and organizations to be active participants in these governance mechanisms. The shared agenda is also an important facet of the operation of this industry-level management control system as the agenda items provided a strategic focus for

the discussions and decision making processes and enforced authority and accountability on the industry participants. Second, these industry-level governance mechanisms enabled the expansion of networks and relationships beyond the organizational boundary. This was made possible by inviting a wide range of managers and organizations to be involved in these industry workshops, conferences and committees to take part in discussions and decision making processes. This interaction type helped to develop connections and relationships between managers from different producer and supply organizations in the industry. These networks and relationships provided a basis for managers to maintain a strategic dialogue during these meetings and also outside these meetings.

Industry organizations and governance mechanisms also played an important role in developing cooperation between organizations involved in the open strategy process. Industry organizations provided the platform for a common set of values setting out a strategic direction to be shared with managers from different organizations within the industry. The industry-level governance mechanisms such as workshops, conferences and committees, which hosted managers from different organizations, provided an extended platform for these values to be shared and taken back into the individual firms for dissemination. Through these industry management control systems (industry organizations and governance mechanisms), other elements of the cultural systems such as symbol-based controls (co-location) and clans were also elevated to become *between* organizations and industry-level management controls. These industry-level management control systems provided a platform for the symbols-based systems such as co-location to encourage different groups of managers to engage in strategic dialogue to help develop new strategic information as part of the open strategy process.

Coordination of strategic activities was also made possible by planning and measurement systems (Malmi & Brown, 2008, Simons, 1995). Planning systems (strategic and action plans) have helped carry out open strategy processes through development and alignment of strategic objectives, alignment of behaviours of managers to strategic actions required and programming and scheduling of these actions. This has provided a common focus to managers from different organizations.

Measurement systems (eg: environmental audit) have helped carry out open strategy process activities by helping to assess current performance, identify gaps and actions to fill these gaps, and enabled feedback and discussion to develop new strategic actions and information. Administrative systems (industry organizations and governance mechanisms) provided the context and the platform for these planning and measurement systems to be extended beyond the organizational boundary to operate as industry-level MCS that helped to coordinate strategic activities related to open strategy processes.

In an open strategy process, individual organizations need to be able to appropriate the benefits from the collaboration that they have contributed to by providing resources and support. Procedures and policies are a mechanism which can be used to share the benefits of the open strategy process. Our case findings explain how this "best practice" mechanism was used. This mechanism provided coordination and sharing of new information in a number of ways. First, new information from R&D projects were developed into best management practice procedures (BMP). These procedures were based on this new information and also on cotton growing practices in other cotton production systems. These procedures were reviewed and discussed by managers from different organizations at industry meetings and workshops. This interaction enabled collaboration, coordination and sharing of new information.

Second, individual organizations and managers were able to access new information for use in organizational-level strategy development and implementation. Third, this mechanism provided a basis for individual organizations to assess their operational strategy and operational activities, to identify gaps for improvement, and to plan for the development and implementation of new strategy. Finally, this mechanism provided a basis for assessing and managing operational risks at the organization-level by enabling them to identify and prioritise the gaps between their current strategic and operational activities and these best management practices, and helped to plan for the development and implementation of revised strategic and operational practices.

Our case findings also highlighted the importance of two meta-capabilities for the open strategy process. Meta-capabilities are broader organizational attributes that drive the efficacy of operating pursuits in organizations such as open strategy processes (Holland, 2008, Miles, Snow & Miles, 2000, Nussbaum, 2000, Snow, Miles & Miles, 2005). Different types of these meta-capabilities have been identified (eg: Snow, Miles & Miles, 2005) but our findings relate to strategic insight and resource fluidity[22] (Doz & Kosonen, 2010, 2008) as two important meta-capabilities for open strategy processes.

Our case findings demonstrate how strategic insight was developed and used to enable managers in different organizations to engage with the open strategy process. Broad and stretching strategic objectives required managers to think outside the box to develop new information to develop improved operational practices. R&D was used to experiment with ideas to develop new information. The platforms provided by the industry-level control systems and practices, particularly the industry organizations and governance mechanisms enabled these managers to develop and maintain a strategic dialogue across the industry to develop open strategy which was then used by individual organizations to improve their organizational practices.

Industry organizations assisted resource fluidity by enabling flexible allocation of capital and labour to finance and carry out open strategy process activities. Industry organizations helped to aggregate of capital funds from individual organizations into R&D investment pools which were then used to attract other funding. These R&D investment pools helped to secure matching funds from other sources (mainly, from the Australian Government) to develop an investment funding pool which was used to resource R&D projects. These projects provided research outcomes which were developed into new strategic information that was made available to all organizations participating in the open strategy process.

[22] Strategic insight relates to the strategic mindset of managers in a complex and fast moving industry environment and is based on three key activities: establishing "stretch" strategic objectives, experimenting with new ideas and establishing and maintaining strategic dialogues (Doz & Kosonen, 2010, 2008). Resource fluidity provides a basis for flexible allocation of capital and people to carry out activities related to open strategy processes (Doz & Kosonen, 2010, 2008).

These industry organizations and governance mechanisms (workshops and conferences) were also used to enable the modular deployment of people to open strategy process activities. Industry organizations have been used to bring people with specific research skills together to work on R&D projects. This modular deployment of people resources has enabled open strategy process activities.

The inclusion of key managers in workshops and conferences enabled strategic dialogues, sharing of information and execution of a range of actions to develop new information for operational strategy development. The inclusion of key managers in these governance mechanisms enabled the modular deployment of people resources who continued to maintain their functional roles within individual organizations.

Conclusions

Open strategy processes have become an important feature of inter-organizational relations in many industries. These processes involve the extension of strategic activities beyond the organizational boundaries and collaboration between multiple organizations and their employees. MCS have been used innovatively as industry-level mechanisms to enable and facilitate this collaboration by encouraging cooperation between these organizations and through coordination of strategic activities and the sharing of resources to carry out open strategy processes.

Our study explains why and how organizations engage in open strategy processes by using resource dependence theory (RDT) to explain how organizations manage and eliminate constraints caused by resource based interdependencies. Our findings address a specific configuration of this interdependency where multiple organizations are highly mutually dependent (Casciaro & Piskorski, 2005). However, these researchers also identify 8 other types of configurations which have had limited empirical examination. Accounting researchers could carry out further research into these different RDT configurations.

This study has examined how MCS are used innovatively as industry-level mechanisms to enable open strategy processes in the cotton industry. Other open strategy processes in different industry settings could be examined to develop a broader understanding of these open strategy processes and how MCS are designed and used to enable them.

In their original formulation of RDT, Pfeffer & Salancik (1978) conceived this theory as providing an explanatory logic for the process of management control in organizations- "to understand the behaviour of an organization, you must understand the context of that behaviour….this point of view is important for those who seek to understand organizations as well as those who seek to manage and control them" (p1). However, there has been limited interest in RDT in management accounting research involving MCS. Hopefully, our study makes a contribution to rectifying this neglect of RDT and employing it in helping us to better understand a contemporary phenomenon-open strategy processes.

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Appendix 1

List of Interviews

Stage	Interviewee	Type	Method	Duration
Familiarisation/ preparation	1. Policy officer, Cotton Australia	Face to face	Taped	1 hour
	2. Independent consultant	Face to face		2 hours (two interviews)
	3. Senior Executive, CRDC (CC2)	Face to face		1 hour
	4. Senior Executive, Cotton Australia	Face to face		1 hour
	5. Research Manager, Cotton Australia (CC1)	Face to face		1 hour
Primary data collection	1. Senior Manager Cotton Firm	Face to face	Taped	1 hour
	2. Senior Manager CRDC		Taped	2 hours
	3. BMP Officer, CMA/CRDC		Taped	40 minutes
	4. Cotton Consultant		Notes	1 hour
	5. Senior Executive & Senior Manager, Cotton Firm	Face to face -group interview	Taped	1.5 hours
	6. Marketing Manager, Cotton Firm	Face to face	Taped	2 hours
	7. Human Geographer/Researcher, UNSW	Face to face	Notes	1 hour
	8. Program Manager, CRDC	Face to face	Notes	2 hours
	9. Regional Executives 1 & 2, Cotton Australia	Face to face -group interview	Notes	2 hours
	10. Regional Executives 3 & 4, Darling Downs, Cotton Australia	Face to face -group interview	Notes	1 hour
	11. Senior Marketing Executive, QLD Cotton Firm	Face to face	Taped	1 hour
	12. Program Manager, Cotton	Face to face	Taped	1 hour

Stage	Interviewee	Type	Method	Duration
	CRC			
	13. Senior Executive (CC2), CRDC	Face to face	Taped	2 hours (2 interviews)
	14. Senior Operations Executive, Cotton CRC	Face to face	Taped	2 hours
	15. Senior Executive, Cotton CRC	Face to face	Taped	2.5 hours (three interviews)
	16. Education & Extension Program Leader, Cotton CRC	Face to face	Taped	1 hour
	17. Project Management Officer, Cotton CRC	Face to face	Taped	1 hour
	18. Board member 1, Cotton CRC	Face to face	Taped	1 hour
	19. Board member 2, Cotton CRC	Face to face	Taped	1 hour
	20. Managers 1 & 2, Cotton CRC	Face to face -group interview	Taped	1 hour
	21. Program Leader, Cotton CRC	Face to face	Taped	1 hour
	22. Board member (DA), Cotton CRC	Face to face	Taped	1 hour
	23. Research Manager, Cotton Australia (CC1)	Face to face (over 2 days)	Taped	4 hours (two separate interviews)
	24. Ex-Senior Executive, Cotton Australia	Face to face	Taped	2 hours
	25. Senior Executive, Cotton Australia	Face to face	Taped	1 hour
	26. Senior Executive, CRDC	Face to face	Taped	1 hour
	27. Program Manager (CC3), CRDC	Face to face	Taped	2 hours

Stage	Interviewee	Type	Method	Duration
	28. Directors (1&2), Public Accounting Practice	Face to face -group interview	Taped	1.5 hours
	29. Senior Manager, CRDC	Face to face	Taped	1 hour
	30. Senior Executive, Cotton Seed Firm	Face to face	Taped	1 hour
	31. Research Scientist, CSIRO	Face to face	Taped	1 hour
	32. Principal Research Scientist, CSIRO	Face to face	Taped	1 hour
	33. Project Officer, NSW Dept of Primary Industry (DPI)	Face to face	Taped	1 hour
	34. Senior Research Scientist, NSW DPI	Face to face	Taped	1 hour
	35. Research Program Leader, CSIRO	Face to face	Taped	1 hour
	36. Director & Principal Research Scientist, NSW DPI	Face to face	Taped	1 hour
	37. Research Agronomist, NSW DPI	Face to face	Taped	1 hour
	38. Team Leader, CSIRO	Face to face	Taped	1 hour
	39. Retired Research Scientist, CSIRO	Face to face	Taped	2 hours
	Total Interviews & hours	**54**		**59 hours 10 minutes**

Appendix 2
List of Archival Records Examined

Industry reports/ publications/news articles

1. Cotton Pest Control in Australia Before and After Bt cotton: economic, ecologic and social aspects, David Murray, Department of Primary Industries, Toowoomba
2. Management of pyrethoid and endosulfan resistance in Helicoverpa armigera in Australia, Bulletin of Entomological Research, Supplement Series, September 1998
3. Impacts of Bt Transgenic Cotton on Integrated Pest Management, Steven Naranjo, Journal of Agricultural and Food Chemistry, 2010
4. Review of Insecticide Resistance Management Principles in the Australian Cotton Industry, NSW Department of Primary Industries and Australian Cotton CRC
5. Prevention and management of Insecticide Resistance in Vectors of Public Health Importance, Insecticide Resistance Action Committee, 2011
6. Communication Plan, Discussion Paper, TransFact, April 1994
7. Economic, Environmental and Social Sustainability Indicators of the Australian Cotton Industry, Guy Roth, 2010
8. The Australian cotton water story, A decade of Research & Development 2002-12, Cotton Catchment Communities CRC Limited
9. A historical geography of cotton farming in NSW and QLD-adaptation and adoption, Wendy Shaw, UNSW, 2012
10. Report on a Scoping Project for the Land and Water Resources Research and Development Corporation on an Overview of the R&D program: Minimising the Impact of Pesticides on the Riverine Environment using the Cotton Industry as a model, James Doak, 1995
11. Minimising the Impact of Pesticides on the Riverine Environment: key findings from research with the cotton industry-1998 conference, Occasional Paper 23/98, Land & Water Resources R&D Corporation
12. Independent Program Review: Minimising the Impact of Pesticides on the Riverine Environment using the cotton industry as a model, Land & Water Resources R&D Corporation, CR Harris, 1996
13. Managing the environmental impacts of cotton growing-an Australian perspective, ACGRA, Alan Williams

14. Case study: Development of the Australian Cotton Industry Best Management Practice (BMP) Program, WWF-Australia, 2005
15. Evaluation of the Australian cotton industry Best Management practices program, Macarthur Agribusiness, Brisbane, 2004
16. Minimising Riverine Impacts of Endosulfan used in Cotton Farming-A Science into Practice Environmental Success Story, Nick Schofield, Alan Williams, Rachel Holloway and Bruce Pyke, Land & Water Australia and CRDC
17. Advances with Integrated Pest Management as a Component of Sustainable Agriculture: The Case of the Australian Cotton Industry, Gary Fitt, CSIRO, 2009
18. 1991 Environmental Audit Recommendations and industry responses, The Australian Cotton Grower, November/December issue
19. The Impact of Pesticides on the Riverine Environment with specific reference to Cotton Growing, Barrett Purcell & Associates Pty Limited, December 1991
20. Action Plan for the Australian Cotton Industry-a response to the Environmental Audit 1991
21. An Environmental Audit of the Australian Cotton Industry, Gibb Environmental Sciences & Arbour International, October 1991
22. External Review: Australian Cotton Industry Best Management Practice Audit Program, CRDC report 276, 2006
23. The development and assessment of the Cotton BMP program into a comprehensive Environmental Management System through the development of a Land and Water module-Final report, Cotton Australia
24. Case Study 4: Best management practice in the Australian cotton industry, 2005
25. The Cotton Model: a model for Minimising the impact of Pesticides on the Riverine Environment, Land & Water Resources R&D Corporation, 1998
26. Implementation pathways for BMP, James Doak, Land & Water Resources R&D Corporation, June 1998
27. A Time Series of the Australian Cotton Industry, 1962 to 2009, Janine Powell, Research Economist, Industry & Investment NSW
28. Evaluation of the Impact of Research Projects Relating to Australia's Natural Resources, Temtac Pty Limited, June 2000
29. Research's contribution to the evolution of the Australian cotton industry, Greg Constable, CSIRO, 2004

30. 10 Years of GM Cotton-where to from here? Jeff Bidstrup, Outlook Conference 2006
31. Taking Responsibility for our future: The Australian cotton industry action response to the Second Australian cotton industry Environmental Audit 2003, Report published in 2005
32. Disease ratings: Another management tool for cotton growers, Greg Salmond, Cotton CRC, 2003
33. Second Australian Cotton Industry Environmental Audit: Executive Summary, CRDC, 2003
34. Fostering best management practices in natural resource management-towards an environmental management system in the cotton industry, A&A Williams Pty Limited, 2001
35. Cotton Pesticides in Perspective, Cotton CRC, 2000
36. Extracts of news articles on pesticide contamination issues between 1998-1999 from the Sydney Morning Herald, Australian Associated Press, Herald Sun, Daily Telegraph and cotton industry specific news publications
37. A snapshot of the Cotton Australia TIMS Committee in 2009, Australian Cotton Grower, April/May issue.
38. Cotton: Focus on BMP, Cotton Australia, May 2004
39. An Australian approach to IPM in cotton: integrating new technologies to minimise insecticide dependence, Gary Fitt, Crop Protection Journal, 2000
40. Integration of Bt Cotton in IPM systems: An Australian Perspective, Gary Fitt & Lewis Wilson, Second International Symposium on Biological Control of Arthropods

Annual Reports

1. Cotton CRC, Annual Reports, 1994-2012
2. CRDC, Annual Reports, 1991-2013
3. Cotton Australia, 40th Anniversary Report and Timeline, 2011/2012
4. Cotton Australia, Annual Reports 1990-2013

Strategic Plans

1. CRDC Strategic Plan, 1998-2003, 2004-2009, 2009-2013, 2014-2019
2. CRDC Annual Operating Plans, 1998-2013
3. Cotton Australia, Strategic Objectives and Plan, 1989/90

4. Cotton Australia, Strategic Plan, 2009-2013, 2013-2018
5. Cotton Australia, Annual Operating Plans, 2009-2013
6. Cotton CRC, Strategic Plans, 1994-2012
7. Cotton Sector Research Development and Extension Final Strategy, June 2011

Governance documents/Minutes of Meetings

1. ACGRA Executive committee meeting minutes-February 1994-July 1997
2. ACGRA Executive committee meeting minutes- April 1988-March 1993
3. ACGRA Constitution
4. The New Research & Development Corporation for Cotton, Richard Williams, ACGRA, 1990
5. Australian cotton conference agenda and proceedings, 1990-1996
6. Memorandum by Chair of ACGRA on Transgenic cotton issues to cotton growers, March 1994

Appendix 3

Field Observation Data

Date/Duration/ Location	Group	Purpose	Data collected
17 April 2012 2 Hours 50 minutes CRDC office, Narrabri, NSW	Project Steering committee-3rd Environmental Audit	The role of the committee was to manage the Audit process and to review the preliminary findings Participants on the committee included managers from Cotton Australia, CRDC, Cotton CRC, cotton consultants and cotton growers.	Audit process Coverage of cotton growers Audit questions Audit responses Emerging issues and trends Problems with the Audit process
5-7 August, 2012 24 hours Broadbeach, Gold Coast, Australia	Australian Cotton conference	Bi-Annual industry conference providing a forum for cotton growers, cotton researchers and other industry stakeholders to meet, discuss and share information.	R&D projects and outcomes Industry information and knowledge Contacts for further interviews and data access
20 November, 2012 2.5 hours Swiss Grand Hotel, Bondi Junction	Cotton Australia Research Panel: Human Capacity	The panel is one of 4 research panels set up to call, review and approve R&D projects for the cotton industry. Membership on the panel included cotton growers, cotton researchers and managers from Cotton Australia and CRDC	R&D approval & monitoring process Details on specific R&D projects Links between R&D projects and strategy process Problems with R&D projects New R&D project ideas
20 November, 2012 2 hours Swiss Grand Hotel, Bondi Junction	Cotton Australia Research Panel: Bio Security	The panel is one of 4 research panels set up to call, review and approve R&D projects for the cotton industry. Membership on the panel included cotton growers, cotton researchers and managers from Cotton	R&D approval & monitoring process Details on specific R&D projects Links between R&D projects and strategy process Regulatory issues Problems with R&D projects

Date/Duration/ Location	Group	Purpose	Data collected
		Australia and CRDC	New R&D project ideas
21 November, 2012 2 hours Swiss Grand Hotel, Bondi Junction	Cotton Australia General Members meeting	General meeting of cotton grower members of Cotton Australia. Forum for updating members on key strategic and operational issues Participants included cotton growers, managers from CRDC and Cotton CRC, cotton consultants and cotton researchers	Strategy process update including key strategic issues and challenges R&D project approval and monitoring updates Information and ideas on new issues and challenges Regulatory and stakeholder issues Marketing and value chain issues