

**Managing cooperation
control problems in
inter-organisational
research and development
exchanges**

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Certificate of original authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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List of abbreviations

ABARES	Australian Bureau of Agricultural & Resource Economics & Sciences
ACGRA	Australian Cotton Growers Association
ACRI	Australian Cotton Research Institute
BMP	Best Practices Management (program)
CA	Cotton Australia
CEO	Chief Executive Officer
CMT	Company management team
COO	Chief Operating Officer
Cotton CRC	Cotton Cooperative Research Centre
CRDC	Cotton Research and Development Corporation
CSD	Cotton Seed Distributors
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Forestry and Fisheries
DIISR	The Department of Innovation, Industry, Science and Research
FRP	Full research proposal
KPIs	Key performance indicators
M&E	Monitoring and evaluation (program)
MCS	Management control systems
NSWDPI	New South Wales Department of Primary Industries
OECD	Organisation for Economic Co-operation and Development
PIERD Act	Primary Industries and Energy Research and Development Act 1989
PRP	Preliminary research proposal
QDAFF	Queensland Department of Agriculture, Fisheries and Forestry
R&D	Research and development
RAG	Red Amber Green (report)
RDC	Rural Development Corporation
TCE	Transaction cost economics

Abstract

Most scholarly knowledge about the management control of research and development (R&D) is premised on a vertical integration model of R&D management; however, in practice, R&D is increasingly being externally contracted through inter-organisational arrangements. Within this context, the aim of this thesis is to examine how cooperation control problems, which arise in inter-organisational R&D exchanges, are addressed by alternative hybrid structures and embedded management control systems (MCS)? To explore this question I investigate two inter-organisational R&D arrangements – a flexible subcontracting arrangement and a limited life equity alliance – within the Australian cotton industry.

First, I use theory from transaction cost economics (TCE) to demonstrate the relevance of cooperation control problems in inter-organisational R&D exchanges. Furthermore, by decomposing the cooperation category I show how the risk of different forms of opportunism gives rise to three types of cooperation control problems at successive contractual phases. These are: costly (*ex ante*) negotiation of mutually agreeable projects contracts; suboptimal investment decisions based on misrepresented information (at the point of contract); and the difficulty in monitoring and enforcing (*ex post*) contract compliance.

Second, I explain how cooperation control problems are addressed by inter-dependent combinations of hybrid structure and embedded MCS. This demonstrates that hybrid governance is not simply the generic inter-organisational context where control occurs; instead, alternative hybrid structures – characterised by varying degrees of formalisation, centralisation and relational governance – have different ‘control solving capacities’. In addition, each hybrid structure’s unique control capacity influences the design and operation of embedded MCS. This is because some MCS – particularly more structure-wide mechanisms – are used to complement the strengths of each hybrid structure; whereas other MCS – typically project-level mechanisms – are used to compensate for deficiencies of each hybrid structure in relation to certain control problems or transactions.

Finally, I explore how control problems and control solutions relate. Based on my empirical results, I propose that each successive control solution choice is determined by a ‘residual control problem potential’, which is shaped by the adequacy of previous control solution choices. In addition, I predict when the relation between control problems and solutions will not hold. I propose that managers will trade-off transaction-level misalignment to avoid portfolio-level negative effects in terms of cost efficiency, internal congruence and perceived equity.

Chapter 1: Introduction

1.1. Research objective

Organisations that choose to satisfy their technological and innovative needs by contracting with external providers, rather than through their own in-house development, are exposed to a heightened risk of opportunism¹ by autonomous trading counterparts (Williamson 1985). Besides the threat of appropriation of intellectual property (Gulati & Singh 1998; Leiblein, Reuer & Dalsace 2002; Oxley 1997; Pisano 1989; Sampson 2004; Teece 1986), organisations who engage in external contracting of research and development (R&D) face problems in ensuring the cooperation of specialised provider agencies upon whom they depend (Arrow 1969; Coase 1937). For example, organisations may face costly negotiation of mutually agreeable project contracts; poor investment decisions due to supplier misrepresentation; and difficulties in monitoring and enforcing ex post contract compliance. The objective of this thesis is to explore how organisations respond to these cooperation problems which arise in inter-organisational R&D exchanges.

To frame this investigation, I apply the constructs and logic of ‘cooperation control problems’ and ‘control solutions’ (Caglio & Ditillo 2008; Dekker 2004; Vosselman 2012) to conceptualise the risks of opportunism anticipated by managers, and the organisational responses aimed at addressing those risks. In general, a ‘control problem’ describes the context-specific imperatives for “why observed control patterns or control structures exist” (Vosselman 2012, p.5); correspondingly ‘control solutions’ are the structures and mechanisms that form ‘stable responses’ to control problems (Caglio & Ditillo 2008; Vosselman 2012).

‘Cooperation’, from the Latin *cooperari*, meaning *co-* ‘together’ and *operari* ‘to work’, can be defined as the action of working jointly towards the same end, for a common purpose or benefit. Thus, ‘cooperation control problems’ occur where a managerial response is required to ensure the alignment of effort towards a collective goal. In an inter-

¹ ‘Opportunism’ refers to when a party acts out of their own self-interest in order to achieve an advantage for themselves at the cost or detriment of others (Simon 1957; Williamson 1985).

organisational context, this occurs when “autonomous partners may have incentives to cheat and free-ride in order to attain their own specific goals at the expense of the objectives of the collective undertaking, so they [the partners] need to introduce mechanisms to align their objectives” (Caglio & Ditillo 2008, p.891).

Research examining cooperation control problems has typically relied on theory from transaction cost economics (TCE).² TCE theory suggests that the potential for cooperation control problems is greatest in idiosyncratic transactions. This is because in idiosyncratic transactions high uncertainty constrains parties’ ability to specify complete contracts for all contingencies, and high asset specificity creates dependency between contracting parties – thus creating opportunities for parties to take advantage of the other (Williamson 1979, 1985, 1991, 2010).³ Seen through a TCE lens, the specialised, uncertain traits that are not only inherent, but also desirable attributes of R&D activities appear to represent the type of complex transactional situation conducive to cooperation issues. For example, R&D projects often require researchers to possess highly specialised knowledge, expertise, and equipment that cannot be easily transferred to other activities (Ditillo 2004); they are characteristically unpredictable, and difficult to observe and monitor (Abernethy & Brownell 1997; Davila 2000); and they often are non-recurring and idiosyncratic (Jørgensen & Messner 2010).

There are a variety of control solution conceptualisations depicting how organisations respond to cooperation problems. One alternative, derived from classical TCE theory (Williamson 1985, 1991), is the choice of governance structure⁴ used to administer an

² Several literature reviews show TCE has been the dominant theoretical lens used to explore the management control implications of inter-organisational settings, particularly in relation to cooperation control problems (e.g. Anderson & Dekker 2010; Caglio & Ditillo 2008; Håkansson & Lind 2006; Meira et al. 2010; Van der Meer-Kooistra & Vosselman 2006; Vosselman 2012).

³ A third transactional characteristic – frequency – is also associated with cooperation control problems, in that low transactional recurrence reduces the long-term cost of opportunism in the short-term (Shelanski & Klein 1995; Tadelis & Williamson 2013; Williamson 1998); although the empirical support for this attribute is much less consistent (Macher & Richman 2008).

⁴ ‘Governance structure’ or ‘organisational structure’ is treated by MCS scholars as a key element of an organisation’s MCS package (e.g. Malmi & Brown 2008). However, for the sake of understanding how TCE and MCS theories may complement each other in conceptualising control solutions to inter-organisational cooperation problems, governance structure will be treated separately from other types of MCS in this thesis. This is consistent with approaches which view organisational structure as simultaneously a control system as well as a context for other control systems (e.g. Flamholtz 1983; Flamholtz, Das & Tsui 1985).

exchange. This could range from use of an arm's length market to complete vertical integration within a hierarchy (Anderson, Glenn & Sedatole 2000; Sartorius & Kirsten 2005; Speklé, van Elten & Kruis 2007; Vosselman 2002; Widener & Selto 1999). In the presence of cooperation hazards, the most logical inter-organisational alternative is a hybrid governance structure⁵ (Barney & Hesterly 2006; Gietzmann 1996; Macher & Richman 2008; Sartorius & Kirsten 2005; Shelanski & Klein 1995; Speklé 2001; Williamson 1991). Hybrid governance can be defined as any arrangement "in which two or more partners pool strategic decision rights as well as some property rights while simultaneously keeping distinct ownership over key assets, so that they require specific devices to coordinate their joint activities and arbitrate the allocation of payoffs" (Ménard 2013, p.1066).⁶

Alternatively, inter-organisational cooperation control problems may also be addressed through the choice of management control systems (MCS) that are embedded within hybrid governance structures (Anderson & Dekker 2010; Caglio & Ditillo 2008). Embedded MCS can be defined as "the systems, processes and mechanisms put in place to ensure the hybrid's objectives are achieved" (Langfield-Smith 2008, p.345).

Within the accounting domain, many researchers have studied the management control of cooperation issues in inter-firm environments (Anderson & Dekker 2010; Caglio & Ditillo 2008; Håkansson & Lind 2006; Meira et al. 2010; Van der Meer-Kooistra & Vosselman 2006; Vosselman 2012). There has also been growing interest in the management of inter-organisational R&D (Dekker 2004; Gietzmann 1996; Gietzmann & Larsen 1998; Miller, Moll & O'Leary 2012; Miller & O'Leary 2005a; Miller & O'Leary 2005b; Miller & O'Leary 2007; Mouritsen, Hansen & Hansen 2001; Revellino & Mouritsen 2009). However, as yet, there has been very little overlap between these two pursuits (with the exception of Dekker 2004; Gietzmann 1996; Gietzmann & Larsen 1998). My aim in this

⁵ This is because outside the bounds of hierarchy, externally mediated transactions require some other form of safeguarding. Market governance, which is characterised by arm's length transactions between faceless buyers and suppliers, relies on the legal enforcement of relatively complete contracts and the discipline of large numbers competition to curb opportunistic behaviour. However, these mechanisms are less effective when confronted with more idiosyncratic transactions, such as R&D: higher uncertainty limits the completeness of contracts; and, asset specificity reduces the potential pool of suppliers to switch to (Williamson 1991).

⁶ This economics definition of hybrids is broader than what has typically been studied in management accounting (Lind & Thrane 2010).

thesis is to integrate and extend upon both streams of work, by adopting the conceptual framing of cooperation control problems and solutions to investigate the challenges of managing inter-organisational R&D exchanges. Thus, the central research question I aim to address in this thesis is:

How are cooperation control problems, which arise in inter-organisational R&D exchanges, addressed by the control solutions of hybrid structure and embedded management control systems?

1.2. Motivation

Businesses and governments devote significant resources towards R&D activities to develop technologies and expertise that fuel economic growth and solve complex societal problems (OECD 2012).⁷ It is therefore unsurprising that for several decades, the management of R&D has been the subject of substantial scholarly inquiry⁸, including in a ‘new paradigm’ of accounting research (Davila, Foster & Oyon 2009) that examines the relevance of management control to innovation processes⁹ (Berhausen 2012; Bisbe & Otley 2004; Brown & Eisenhardt 1995; Cardinal 2001; Davila 2000; Davila, Foster & Li 2009; Davila, Foster & Oyon 2009; Ditillo 2004; Dunk 2011; Jørgensen & Messner 2010; Mouritsen, Hansen & Hansen 2009; Nixon 1998; Simons 1995). However, as the majority of this prior research is premised upon a vertical integration model of R&D (Chesbrough, Vanhaverbeke & West 2006), its utility may be limited by changes in current business practices that alter traditional boundaries of organisational entities (Ford & Håkansson 2010; Hopwood 1996; Otley 1994).

⁷ On average, in OECD countries public expenditure on R&D is 0.72% of GDP and business expenditure on R&D is 1.27% (OECD, 2012). To give a sense of scale, this is equivalent to the value of military expenditure, which in OECD countries in 2012 was an average of 1.6% of GDP (Stockholm International Peace Research Institute (SIPRI) 2013), and double what OECD countries spend on unemployment (OECD 2010), or on road and rail infrastructure (International Transport Forum 2012).

⁸ Since the end of the Second World War, the management of R&D has been studied by numerous scholars (Creswell 1985; Geiger 1991; OECD 1999), in fields such as higher education, organisation studies, sociology, and management. For an overview of this work readers are referred to several comprehensive reviews (e.g. Andrews 1979; Bland & Ruffin 1992; Bland et al. 2005; Creswell 1985; Fox 1983; Glueck & Thorp 1971; Pelz & Andrews 1976; van der Weijden et al. 2008).

⁹ In this thesis I conceive of R&D activities as a subset of the broader category of innovation processes.

In practice organisations are increasingly relying on external networks of specialised research providers to access a wider range of competencies than could be maintained in-house (Chesbrough 2003a, 2003b; Ding, Dekker & Groot 2010; Hagedoorn 2002; Powell & Grodal 2005). By using an external contracting approach organisations can accelerate development by pursuing different technological options simultaneously (Powell 1990; Sampson 2004). Inter-organisational modes, including cross-licensing, strategic alliances, outsourcing, collaborative partnerships, co-locations and joint ventures, all require the management of R&D to occur across (rather than within) organisational boundaries (Chesbrough, Vanhaverbeke & West 2006; Powell, Koput & Smith-Doerr 1996). This has several implications: it changes the focal subject of control from operational activities performed by in-house employees to discrete ‘R&D exchanges’¹⁰ with autonomous trading parties; it introduces greater divergence of interests; and it reduces the capacity to enact traditional hierarchical forms of control. As a result, like all inter-firm arrangements, inter-organisational R&D exchanges prompt three categories of control problems: how to *coordinate* decentralised activities and manage interdependencies; how to protect against *appropriation* and ensure the fair distribution of joint outputs; and how to ensure *cooperation* between the parties (Caglio & Ditillo 2008; Dekker 2004; Speklé 2001; Van der Meer-Kooistra & Vosselman 2006).

Several accounting researchers have studied the management of inter-firm R&D in commercial contexts such as the subcontracting of design and development work (Gietzmann 1996; Gietzmann & Larsen 1998; Mouritsen, Hansen & Hansen 2001; Revellino & Mouritsen 2009), inter-firm R&D networks (Miller, Moll & O’Leary 2012; Miller & O’Leary 2005a; Miller & O’Leary 2005b; Miller & O’Leary 2007), and equity-based alliances (Dekker 2004). These authors describe MCS found in these inter-firm settings, including planning devices, central decision-making bodies, performance monitoring systems and incentives. However, they rationalise the use of MCS predominantly in terms of their capacity to address coordination and appropriation

¹⁰ In this thesis, an ‘R&D exchange’ occurs when resources are provided in exchange for the conduct of research activities and the production of research outcomes.

problems. The management of cooperation problems in inter-organisational R&D remains largely unexplored.

Therefore, in this thesis I study how parties address cooperation problems arising in inter-organisational R&D exchanges. In particular, without the convergence of interests that unified ownership provides or the capacity to enact traditional managerial control, how do parties protect against the risk that their counterpart will act opportunistically to further their own self-interest?

1.2.1. Conceiving of cooperation problems

Similar to previous accounting studies, I use TCE theory to conceptualise how cooperation control problems arise as a result of certain transactional characteristics that enhance the risk of opportunism. Previous studies tend to conceive of a single aggregate cooperation control problem based on a general conception of opportunism (e.g. Dekker 2004; Johansson & Siverbo 2011; Langfield-Smith 2008; Langfield-Smith & Smith 2003; Speklé 2001; Van der Meer-Kooistra & Vosselman 2000). This is problematic in two respects.

First, ‘opportunism’ is not a simple, one-dimensional construct; it describes a wide range of self-interested behaviours, such as lying, stealing, cheating or efforts to misrepresent (Williamson 1985). This is significant because different opportunistic risks give rise to different categories and types of control problems. For example, although some authors treat the categories of appropriation and cooperation as somewhat synonymous¹¹ (e.g. Dekker 2004; Gulati & Singh 1998; Sampson 2004; Speklé 2001; Vosselman 2012), appropriation control problems arise because of the risk of theft of property and unfair division of value between parties;¹² in contrast, cooperation control problems arise because of the risk of a broader range of self-interested behaviours by autonomous trading counterparts. Within the category of cooperation, a more nuanced view of opportunism leads to a separation of different types of cooperation control problems. Neumann (2010)

¹¹ This overlap exists because both appropriation and cooperation control problems are behavioural issues, arising from divergences in interests, goals or incentives (Arrow 1969; Coase 1937); contractual issues emerging as a result of assumptions of bounded rationality and opportunism (Williamson 1985).

¹² For example, in an R&D context, appropriation control problems relate to the ‘spillover’ or leakage of intellectual property (Oxley 1997; Sampson 2004).

shows that different forms of opportunism will give rise to more than one type of cooperation control problem, such as exploiting bargaining positions to hold-up¹³ negotiations or taking advantage of information gaps to provide distorted information or shirk effort.

Second, different types of cooperation control problems may require alternative control solutions. Many prior studies have observed the use of different control mechanisms at ex ante and ex post phases of a contractual exchange (Dekker 2004; Donada & Nogatchewsky 2006; Johansson & Siverbo 2011; Nicholson, Jones & Espenlaub 2006; Van der Meer-Kooistra & Vosselman 2000). While it is feasible that different controls may be used to address the same underlying problem, the multiplicity of controls may reflect changing imperatives for control arising at different points in time (Revellino & Mouritsen 2009). It is only by taking a more disaggregated and differentiated approach to cooperation control problems that we can develop a more nuanced understanding of the specific relations between particular types of control problems and particular types of control solutions.

1.2.2. Conceiving of control solutions

While there has been limited prior research about how organisations respond to cooperation problems specifically in R&D settings (Dekker 2004; Gietzmann 1996; Gietzmann & Larsen 1998), there has been substantial investigation of cooperation-related control solutions within the broader accounting literature on inter-organisational arrangements. These inter-organisational control studies suggest that cooperation hazards may be addressed through the choice of governance structure or through the choice of MCS (Anderson & Dekker 2010; Caglio & Ditillo 2008; Håkansson, Kraus & Lind 2010; Håkansson & Lind 2006; Meira et al. 2010; Van der Meer-Kooistra & Vosselman 2006; Vosselman 2012). However, while this body of inter-organisational control research provides some useful indications of the types of MCS likely to be found in R&D exchanges, there are at least three problems in how hybrid structure control solutions have been conceived.

¹³ ‘Hold-up’ refers to when a contracting party intentionally stalls negotiations or engages in excessive haggling tactics to persuade their trading counterpart to accept more favourable contracting terms (Geyskens, Steenkamp & Kumar 2006; Rindfleisch & Heide 1997).

First, within inter-organisational control studies hybrid governance is often equated with a homogenous category of ‘inter-organisational relationships’ that constitute all inter-firm arrangements besides pure market contracting (Caglio & Ditillo 2008; Van der Meer-Kooistra & Vosselman 2000). This generic, ambiguous conception disregards the diversity of hybrid forms found in practice, and may have led researchers to focus on simple dyadic exchanges between a buyer and a supplier with little consideration of more complex, multi-party network forms (Lind & Thrane 2010). In comparison, economic literature reveals a rich assortment of hybrid forms including subcontracting, strategic alliances, franchising, supplier parks, partnerships, consortia, cartels, trade associations, licensing agreements, supply chain systems, cooperatives, networks, reciprocal trading and long-term contracts (Barney & Hesterly 2006; Grandori & Soda 1995; Macher & Richman 2008; Ménard 2004, 2006, 2013; Ménard & Shirley 2005; Shelanski & Klein 1995; Williamson 1991). The comparative lack of variation in hybrid forms within accounting literature creates the risk of a distorted or incomplete view of inter-organisational management control. Furthermore, by disregarding multiple party arrangements – which tend to have more ambiguous organisational boundaries, more divergence in competing interests, and more complicated relations of control – accounting researchers may have neglected to study situations where cooperation control problems are most severe (Anderson & Dekker 2010).

Second, the control capacity of hybrid governance structures has often been overlooked. In many studies, the hybrid structure is treated simply as the context in which cooperation problems are addressed by MCS. This approach disregards the ‘control-solving capacity’ of hybrid governance structures (Grandori & Soda 1995; Gulati & Singh 1998; Ménard 2004, 2006, 2013; Oxley 1997). Also, by studying MCS separately from hybrid governance researchers risk developing flawed models of management control (Caglio & Ditillo 2008). As Anderson and Dekker (2010, p. 258) warn:

...studies that relate the use of individual control mechanism to transactional characteristics will suffer from omitted variable bias if other controls are used in conjunction to manage the same transaction. The failure to recognise such

*interdependencies in the design and use of different control mechanisms results in underspecified models and may generate flawed inferences about control choices.*¹⁴

Third, there is a lack of clarity about the inter-dependencies between hybrid structure and MCS control solutions. Within the studies that do study hybrid structure and MCS simultaneously, there are inconsistencies in the way the MCS-hybrid relation is conceived. For example, some model hybrid-MCS combinations as distinct archetypes or configurations (e.g. Kamminga & Van der Meer-Kooistra 2007; Sartorius & Kirsten 2005; Speklé 2001; Vosselman 2002); whereas others portray hybrid structure and MCS as successive choices within an extended-make or buy decision¹⁵ (Johansson & Siverbo 2011; Van der Meer-Kooistra & Vosselman 2000). Although these studies demonstrate that cooperation control problems are addressed by multiple control solutions (Anderson & Dekker 2010; Caglio & Ditillo 2008), without further clarification, it is not clear how hybrid structure and MCS control solutions relate, interact or combine. Furthermore, this issue has been compounded by the lack of cross-sectional study of MCS within alternative hybrid forms – most studies tend to focus on a single type of hybrid in isolation. It is only by examining how hybrid structure and MCS operate in combination across different types of hybrids that we can understand how the choice of hybrid structure interacts with the choice of embedded MCS.

1.3. This study's empirical approach

To understand how hybrid governance structures and MCS address cooperation control problems, I study two arrangements used to manage inter-organisational R&D exchanges in the Australian cotton industry. This industry is a rich context to observe inter-organisational management practices because it has used various arrangements to collectively fund cotton-related R&D for over 40 years. I investigate two of these arrangements: the Cotton Research and Development Corporation (CRDC), which operates as a subcontracting

¹⁴ This would explain why studies often fail to find consistent evidence that MCS patterns are driven by cross-sectional variation in transactional variables; more commonly MCS patterns appear to be driven by institutional-level factors, such as government regulation, organisational culture or existing control system design (Langfield-Smith & Smith 2003; Van der Meer-Kooistra & Vosselman 2000).

¹⁵ Van der Meer-Kooistra and Vosselman (2000) suggest that in an extended make-or-buy decision, a party first decides the governance structure of a transaction, followed by the type of parties and relational risk to accept, and finally the design of MCS.

arrangement; and the Cotton Cooperative Research Centre (Cotton CRC), which is more akin to an equity-based joint venture. Both arrangements have been responsible for the investment of large collective pools of resources towards R&D activities and have administered several hundred R&D project exchanges between commercial, government and research organisations. To study these two cases I draw on data gathered over a two year period including 64 interviews, 11 observational field trips, and an extensive review of archival documents¹⁶ dating back to 1974. I analyse this data using an abductive approach (Dubois & Gadde 2002) to identify the structures and MCS used in each setting, and to understand how they operate as control solutions, both individually and in combination.

1.4. Theoretical contributions

Using this empirical approach I aim to make three different contributions that extend the development of theory in two bodies of management accounting: research concerning MCS in inter-organisational R&D; and TCE-based inter-organisational management control research.

1.4.1. Cooperation control problems

The first contribution is to use TCE theory to demonstrate the relevance of three different types of cooperation control problems in shaping the design and operation of control structures and mechanisms in inter-organisational R&D exchanges. Combining TCE theory with a three-phase model of a transactional relation (Van der Meer-Kooistra & Vosselman 2000) I formulate three cooperation problems that may arise as a result of different opportunistic risks at different stages of an R&D exchange. They are (i) the risk of costly setup and negotiation of projects because of dependence on specialised providers (*ex ante*); (ii) the risk of poor project investment decisions due to supplier misrepresentation of their capabilities or the parameters of the project (at the point of contract); and (iii) the difficulty in evaluating and enforcing contract compliance in the context of incomplete contracts, information asymmetry and supplier dependence (*ex post*). The specification of these three

¹⁶ Archival documentation includes annual reports; strategic and annual planning documents; external consultants' reports; R&D handbooks, procedures and templates; crop statistics; conference proceedings; and, relevant media reports.

problems is confirmed through first-hand accounts of parties and managers involved in two different inter-organisational R&D arrangements.

Demonstrating the relevance of cooperation control problems constitutes a contribution to inter-organisational MCS R&D theory as it provides a different rationale for the design and use of control structures and mechanisms in inter-organisational R&D. Previous studies have accounted for MCS in terms of their capacity to address coordination or appropriation concerns (e.g. Dekker 2004; Miller & O'Leary 2005a; Miller & O'Leary 2007; Mouritsen, Hansen & Hansen 2001; Mouritsen, Hansen & Hansen 2009); by studying the existence of cooperation problems in a public science setting where appropriation and coordination issues are less pronounced, I show why MCS are also needed to manage the risk of opportunism in inter-firm R&D exchanges.

The decomposition of cooperation control problems into three specific types contributes to inter-organisational MCS research more broadly, by providing further support to Neumann (2010)'s conjecture that different opportunistic risks gives rise to different types of cooperation problems which require alternative managerial responses. Compared to an aggregate formulation of a single cooperation problem based on more a more general risk of opportunism, a differentiated approach to cooperation control problems reveals more nuanced set of imperatives for control solution choices. That is, I show that within a given inter-organisational arrangement, the imperative for hybrid structure and MCS control solutions is not reducible to a single, aggregate risk of opportunistic behaviour; rather, different combinations of control solutions are required to address the risk of different forms of opportunistic behaviour that arise at different contractual phases.

1.4.2. Hybrid and embedded MCS control solutions

The second contribution is to explain how cooperation control problems are addressed by inter-dependent combinations of hybrid structure and embedded MCS control solutions. By integrating inter-organisational MCS research with insights from broader economic literature about hybrid governance, I develop a preliminary conceptual framework of control solution choices including three dimensions of hybrid structure (formalisation, centralisation and relational governance) and four categories of embedded MCS (including

planning, monitoring and reporting systems, incentives and social-based mechanisms). In addition, to conceptualise the interdependencies between hybrid structure and MCS control solutions, I review how prior studies have conceived hybrid-MCS relations which I classify into two approaches. The first, which I label the ‘archetypal approach’, implies that MCS and hybrid structures form into distinct configurations. The second, the ‘misalignment approach’, implies that MCS are used to compensate for misalignment in choice of governance mode. Using this conceptual framing I conduct a cross-case analysis of the combination of control solutions used within two types of hybrids. My results provide empirical support for both the archetypal and misalignment explanations for hybrid-MCS relations: some MCS – particularly more structure-wide mechanisms – are used to complement the functioning of each hybrid structure; whereas other MCS – typically project-level mechanisms – are used to compensate for deficiencies of each hybrid structure in relation to certain control problems or transactions.

These results extend inter-organisational R&D research by providing further detail about the mechanisms which enable the operation of two alternative inter-firm models of R&D management. I explain how the design and operation of MCS and hybrid structure enables the functioning of flexible subcontracting arrangements (Gietzmann 1996; Gietzmann & Larsen 1998; Mouritsen, Hansen & Hansen 2001; Revellino & Mouritsen 2009) and equity-based-alliances (Dekker 2004; Oxley 1997; Pisano 1989; Sampson 2004).

The analysis of the structural dimensions of the two arrangements also contributes a systematic explanation of the control capacity of alternative hybrid governance structures to inter-organisational MCS theory more generally. This demonstrates that hybrid governance is not simply the generic inter-organisational context where control occurs; instead I show that market-like and hierarchy-like hybrid structures have different ‘control solving capacities’ to address cooperation control problems.

Finally, I clarify the inter-dependencies between control solutions by identifying, explaining and differentiating between alternative types of hybrid-MCS relations. I show that within a given inter-organisational arrangement there are complementary relations between the hybrid structure and the MCS that enact its functioning; and compensatory

relations between the hybrid structure and the MCS that provide additional safeguarding in situations of misalignment. Furthermore, I differentiate between two types of ‘compensatory MCS’: standard compensatory MCS used across all transactions to safeguard structural deficiencies in relation to certain types of control problems; and idiosyncratic compensatory MCS used to safeguard structural deficiencies in relation to particular sets of transactions. Finally, I propose that alternative hybrid-MCS relations can be distinguished by the relative breadth of scope of the relevant MCS, the internal congruence in the overall pattern of control, and the pattern of variation in MCS relative to structural and transactional characteristics.

1.4.3. The relation between control problems and solutions

The third contribution concerns the relation between control problems and solutions. Based on my empirical results, I propose that each separable, successive control solution choice is determined by the ‘residual control problem potential’: a construct I develop to describe the adequacy of existing control solutions. To illustrate this premise, I construct a model depicting the dynamic between successive control solutions choices (the type of hybrid; structural dimensions; complementary MCS; standard compensatory MCS; and idiosyncratic compensatory MCS) and more refined residual control problem potentials, which ultimately results in some degree of ‘residual control loss’. This sequencing of the inter-dependent control solution choices aligns to the ordering of choices within earlier depictions of an extended make-or-buy decision (e.g. Johansson & Siverbo 2011; Van der Meer-Kooistra & Vosselman 2000); the relative breadth of scope of control solutions; and the relative ease in adapting control choices.

This model extends management control theory by providing a more nuanced explication of the constructs and logic of control problems and control solutions, which is a style of theorising that is being more widely adopted by accounting researchers to explain the design and use of MCS within inter-organisational settings (Birnberg 1998; Dekker 2003, 2004, 2008; Gulati & Singh 1998; Neumann 2010; Nicholson, Jones & Espenlaub 2006). This explanation also provides a way of conceiving control system design that accommodates the existence of multiple control solutions (Caglio & Ditillo 2008), without presuming a singular holistic design. Instead it portrays control system design as an

ongoing emergent process, where managers ‘triage’ potential control problems with incremental control solutions.

It also shifts attention away from trying to understand what types of control solutions are used in particular contexts, and instead towards explaining how and why control solutions are designed and used. For example, I demonstrate the applicability of the model by using it to depict the relation between cooperation control problems and control solutions in inter-organisational R&D exchanges, which corresponds to the empirical patterns of inter-dependent control choices I observed within the two case studies.

Finally, the application of this model to my empirical results also enables exploration the contexts where the relation between control problems and solutions are not expected to hold, particularly within more complex arrangements with multiple parties and transactions (Lind & Thrane 2010). I propose three reasons why managers will accept a residual control loss greater than zero: the relative cost efficiency of adaptation, the need for internal consistency in control solutions, and the need for equity between different parties. These three reasons potentially explain why management control in multi-party, multi-transaction arrangements is more complex (Anderson & Dekker 2010), as managers have to trade-off the benefits achieving alignment for an individual or subset of transactions versus the costs or negative impacts that are borne at a portfolio or aggregate level.

1.5. Thesis structure

The next three chapters examine existing literature to conceptualise the nature and relation between control problems and solutions in inter-organisational R&D. In Chapter 2, I formulate three types of cooperation control problems by combining our understanding of the inter-organisational R&D context with TCE’s explanation of contractual hazards. In Chapter 3, I conceptualise potential control solutions in terms of choices of hybrid governance and MCS by integrating inter-organisational control research in accounting with insights from economic literature about hybrid governance and empirical studies of inter-organisational R&D. In Chapter 4, I propose how the study’s constructs may relate, by first examining how previous studies have accounted for the two alternative types of interdependencies between hybrid structure and MCS control choices, and then proposing a

preliminary conceptual framework relating control solutions to the three cooperation control problems.

Chapter 5 describes and justifies the multiple-case research method used to collect and analyse empirical material concerning how cooperation control problems are addressed by hybrid structure and embedded MCS. I trace the rationale of a series of choices concerning this empirical approach, including the post-positivist methodology and abductive approach to theory development; the multiple-case study design and the selection of the CRDC and Cotton CRC as suitable cases; and the collection and analysis of interview, observational and archival data.

The following five chapters then present the findings from the two case studies, which progressively abstract from the empirical material to the conceptual implications of the study. In Chapters 6 and 7, I present the case study descriptions summarising the historical background, R&D contracting and management structures and processes I observe within each of the two inter-organisational R&D arrangements. In Chapter 8, I present the cross-case analysis, using the conceptual framework to compare each arrangement's structural dimensions and MCS. This is followed in Chapter 9 by an analysis of the patterns describing the control capacities of the two arrangements and the inter-dependencies between their control solutions. On the basis of this analysis, in Chapter 10, I develop the broader theoretical implications of the study concerning how inter-dependent control solutions relate, and how and why control solutions align to control problems.

Finally, the concluding chapter brings the different lines of inquiry within the thesis to a close and places the work in the context of broader research and practice. I summarise the thesis contributions, explicate the implications for future research and practice, and discuss how the study's limitations shape the interpretation of its results.

Chapter 2: Framing the cooperation control problem of inter-organisational R&D exchanges

2.1. Introduction

The aim of this chapter is to review existing literature in order to formulate the cooperation control problems that are likely to arise in inter-organisational R&D exchanges. To provide context for this formulation, in Section 2.2 I discuss the implications of organising R&D outside the bounds of hierarchical entities. Within this discussion I identify the differences between internal and external R&D exchanges and review existing studies of the management control of inter-organisational R&D. In Section 2.3, I focus more closely on the issue of cooperation by providing an overview of Transaction Cost Economics' (TCE) explanation of why the risk of opportunism arises in inter-organisational settings. Finally, in Section 2.4, I combine this understanding of the inter-organisational R&D context with TCE theory to propose three types of cooperation control problems that may emerge in inter-organisational R&D exchanges.

2.2. Shifting R&D outside the organisation

Numerous scholars in management accounting have explored various challenges of managing R&D; however, the majority of this prior research has been based *within* organisations. For example, studies have problematised the uncertainty of research activities as a constraint on managerial efforts: to ensure behavioural congruence (Abernethy & Brownell 1997; Cardinal 2001; Jørgensen & Messner 2010; Rockness & Shields 1984, 1988); to enable coordination and integration between members or units (Adler & Chen 2011; Den Hertog & Roberts 1992; Ditillo 2004; Hayes 1977); or to engage in meaningful decision-making (Davila 2000; Gowthorpe 2009; Leitner & Warden 2004; Nixon 1998). However, managing R&D *between* organisations may raise different types of control concerns, such as cooperation. The aim of this section is to clarify the nature of the inter-organisational context and its implications for management control. Therefore, in Section 2.2.1 I discuss the differences between internal and external R&D contracting, and

in Section 2.2.2 I review existing accounting studies about the management control of inter-organisational R&D.

2.2.1. Differences between internal and external R&D contracting

An R&D exchange occurs when resources are provided in exchange for the conduct of research activities and the production of research outcomes (e.g. new knowledge, products, services or expertise). Exchanges involve at least two parties¹⁷ – the party that provides the resources (which I refer to as the ‘R&D funder’) and the party who conducts the research (the ‘R&D provider’). There are at least three differences between internal R&D exchanges, which occur between parties that are both integrated within the same hierarchical structure, and external exchanges, which involve parties from different organisations.

The first difference relates to the way R&D activities are contracted. Vertically integrated research activities are conducted by personnel employed by the organisation, and therefore contracted through long-term employment contracts.¹⁸ Depending on the nature of the employment relation, employees are generally held accountable for aggregate outcomes of the entirety of their activities (Williamson 1991). Externally sourced R&D is conducted by contractors; in the absence of employment contracts, these are contracted through project-level agreements. These contracting differences may alter the focal unit of management control. Whereas a long-term employment relation enables the contracting of operational activities that are ambiguous, overlapping and emergent¹⁹, project-based contracting requires the separation of operational activities into more discrete, separate units.

The second difference is the nature of the relation between parties and the degree of alignment between their interests. Although parties to internal R&D exchanges may have divergent or competing interests (e.g. Den Hertog & Roberts 1992; Mouritsen, Hansen &

¹⁷ Other parties may also be involved as intermediaries, advisors or monitors to the exchange.

¹⁸ Employment contracts may vary, with different degrees of specification of the employees’ duties, activities and expected outcomes.

¹⁹ Although I focus on the cooperation implications of contracting, an all-inclusive employment contract could also mitigate proprietary concerns. This is because the organisation is able to contract for the entirety of the employee’s research activities and can lay exclusive claim to all R&D outcomes developed during their employment term.

Hansen 2009), because they remain within a unified ownership structure these interests ultimately converge towards common goals, such as joint profit maximisation or organisational survival (Williamson 1979, 1981). This creates incentive for parties to work cooperatively for the sake of joint profit maximisation and this reduces incentives to sub-optimize (Williamson 1979, 1981). As parties to external R&D contracts do not belong to the same organisation they are likely to have more divergent interests. This is because without a unified ownership structure or collective goal, parties' interests will reflect their own organisational affiliations, priorities and objectives, which diverge because the parties are more specialised (Coase 1937).²⁰

The third difference between internal and external exchanges is the ability of a party to enact traditional management control on another. As employees, internally-based parties surrender substantial decision rights to managers, granting them the authority or 'managerial fiat' to allocate tasks, implement orders, monitor activities, evaluate outcomes, and provide rewards and penalties (Tadelis & Williamson 2013; Williamson 1991). In comparison, parties to external exchanges retain substantial decision rights and autonomy over their own operations. This variation in parties' autonomy has significant implications for management control. In hierarchies, managers have the capacity to organise R&D activities through centralised administrative command and control systems²¹ which are efficient in enabling coordination²² and mitigating opportunism²³ (Ménard & Shirley 2005;

²⁰ The fundamental rationale for external transactions is to take advantage of the division and specialisation of labour between different units of production (Coase 1937).

²¹ 'Command' can be defined as "a relationship in which an agent who performs a job has to report to the person who is in charge and who can be held accountable for the performance of the job thus assigned" (Ménard & Shirley 2005, p.289).

²² Hierarchical governance enables coordination as changes can be dealt with through a cooperative response "that is conscious, deliberate, purposeful" (Williamson 1991, p.4), supervisors can reallocate or reorganise tasks without costly renegotiation of formal contracts (Williamson 1979), and employees with common training, experience and interactions, who develop codes and languages, enables the firm to use responsive and informal information exchanges to adapt to emerging contingencies (Williamson 1971, 1979, 1991, 1996).

²³ Managerial fiat addresses opportunism because supervisors are given the authority and mechanisms to constrain self-interested behaviour and to resolve internal disputes (Williamson 1981, 1991, 1996). Also, hierarchies are generally supported by forbearance law, which respects internal contracting within organisations, without recourse to external courts (i.e. the 'business judgment rule') (Williamson 1996). This means that within hierarchies, exchange parties "resolve disputes internally: they work out their differences themselves, or appeal unresolved disputes to the hierarchy for decision" (David & Han 2004, p.40). This form

Tadelis & Williamson 2013; Williamson 1981, 1985, 1991, 1996). Outside hierarchical structures, because of the absence of managerial fiat, parties cannot exert traditional forms of management control over the other. Therefore they must resort to using alternative mechanisms to coordinate interdependent activities and to protect against opportunistic behaviour.

In summary, organising R&D activities through external contracts appears to represent a substantially different management control context compared to when R&D is vertically integrated within the organisation. Shifting R&D ‘outside’ the organisation changes the focal subject of control from operational activities performed by in-house employees contracted through employment contracts, to discrete project-based ‘R&D exchanges’ contracted with external R&D providers. In addition, because these external providers do not belong to the same unified ownership structure as the R&D buyer, there is a greater likelihood the parties’ interests will diverge. Furthermore, because parties are not subject to managerial fiat authority or traditional hierarchical control, they also have the capacity to pursue their own interests, increasing the potential for opportunistic behaviour. Thus, the combination of characteristics which differentiate the inter-organisational environment also appears to create a different challenge for management control in terms of how buyers ensure the cooperation of provider agencies.

2.2.2. Evidence of cooperation problems in inter-organisational R&D

The aim of this section is to review accounting research concerning the management control of inter-organisational R&D to gain further insight about the nature of cooperation problems in inter-organisational contexts (e.g. Dekker 2004; Gietzmann 1996; Gietzmann & Larsen 1998; Miller, Moll & O’Leary 2012; Miller & O’Leary 2005a; Miller & O’Leary 2005b; Miller & O’Leary 2007; Mouritsen, Hansen & Hansen 2001; Mouritsen, Hansen & Hansen 2009; Revellino & Mouritsen 2009). Although authors have often not framed their investigations around ‘cooperation control problems’, their studies provide various indications that cooperation hazards constitute a relevant set of concerns in inter-organisational R&D.

of ‘private ordering’ is often comparatively efficient compared to outside arbitration and adjudication (Williamson 1981, 1991, 1996).

The first indication these studies provide about cooperation is the recognition that when firms rely on various external arrangements to source R&D they then also become dependent on their trading counterparts. For example, Mouritsen, Hansen and Hansen (2001) study a small electronics manufacturer ('NewTech') that outsourced its technology development activities to a network of external suppliers. Although outsourcing increased the speed of technology development and supported NewTech's competitive position as a 'technology leader', it also exposed the firm to new forms of strategic dependence. The NewTech managers felt 'at the suppliers' mercy' (p.230), because the suppliers often had much greater expertise about the technology and therefore made most of the operational decisions about the technical design of new products, yet NewTech ultimately bore the costs of technology development which did not fit into existing product offerings²⁴, did not achieve required functionality, or were not sufficiently cost-effective in their design.

Similarly, studies of the US semiconductor industry reveal the extensive reliance the company Intel has on its suppliers who develop the process technology and equipment required to improve Intel's development and manufacture of micro-processors²⁵ (Miller, Moll & O'Leary 2012; Miller & O'Leary 2005a; Miller & O'Leary 2005b; Miller & O'Leary 2007). This dependence is significant, as the value of Intel's own activities, investments and products can only be fully realised with coordinated and integrated technology development by its suppliers. As the authors note:

Without corresponding advances by those firms at defined moments, Intel would be unable to operationalize its successive generations of process technologies. The value of advances in microprocessor design would thus be substantially reduced (Miller & O'Leary 2005b, p.89).

In addition Miller and O'Leary discuss Intel's actions to maintain supplier competition in technology development, such as by fostering the parallel development of several alternative technological options by different suppliers, which they may or may not

²⁴ The NewTech managers noted that if new product designs (alarms) could not fit with related products (its central monitoring unit), then the development effort would ostensibly be 'wasted' (Mouritsen, Hansen & Hansen 2001).

²⁵ Intel has successively improved its fabrication process, with a new 'process generation' roughly every three years (Miller & O'Leary 2005b).

eventually adopt. Intel's intention, they explain, is to avoid committing too early to adopting a highly specialised technology option, as this could result in the firm becoming 'locked in' with a particular supplier, and reduce their ability to switch to more effective alternative process innovations at later stages (Miller & O'Leary 2005a).

The issue of dependence arising from specialisation is also raised by Dekker (2004) in his case study of strategic alliance, formed between a buyer and a supplier, involving the supply and joint innovation of railway safety equipment. Dekker explains that because of the particular technological specifications of the equipment being developed²⁶ the buying firm was dependent on the supplier as they would incur significant costs if they were to switch suppliers. Furthermore, because the equipment had been developed specifically for the buyer, the supplier was equally exposed to buyer opportunism; therefore both parties were in a situation of mutual dependence.

The second indication of cooperation concerns in existing research is the discussion of efforts to align the interests of suppliers and induce cooperative behaviour. For example, in Dekker (2004, p. 43) the buyer's main concern was that the supplier "would have little incentives to work actively on innovating the half-barrier installation and just would use the alliance to secure turnover for another 5 years". Furthermore Dekker justifies the development of a financial incentive system to "align partners' interests and to motivate them to perform adequately", and the use of the alliance Board to monitor partners' behaviour.

Likewise, the managers in the Mouritsen, Hansen and Hansen (2001) study reported feeling a 'sense of losing control' as technology development became external to the firm, and "discussed how to reinstall control of development processes which were to be 'aligned with the company'" (p.228). In particular, the managers raised concerns that distance and information asymmetry in outsourcing reduces the ability of managers to monitor and ensure goal congruence of technology suppliers. For example, they had little control over

²⁶ The degree of specialisation was explicitly recognised in the parties' agreement, which stated that "...although other suppliers offer systems with comparable functionality, worldwide no systems are available with similar technological specifications, that would fit well into the existing rail infrastructure" (Dekker 2004, p.42).

the costs embedded in designs developed by external suppliers, and while they were concerned about constraining innovation efforts by exerting too much cost control, “the suppliers were increasingly developing technologies for which NewTech simply did not know the costs” (p.229).

In addition, Revellino and Mouritsen (2009, p. 351) report one of the early concerns by a company attempting to develop electronic toll pass technology but who lacked the requisite competencies, was how to motivate and interest external technology companies “to participate in its realisation of its ambition”. The company tried to leverage off external engineers’ own personal interest, ambition and hobby passions, as well as foster competition amongst ambitious technology suppliers to motivate them to contribute technology solutions to the company. The authors summarise this issue as “engaging others while at the same time not losing control of the innovation... this required making suppliers and partners interested in sharing knowledge and cooperation” (p.352).

A third related issue concerns the incentives suppliers have to embark on joint design and development work with external buyers. This was the focal point of two different articles by Miles Gietzmann. Gietzmann first problematised Japanese subcontracting practices that he observed empirically (Gietzmann 1996), which he then modelled and detailed in an analytical paper (Gietzmann & Larsen 1998). He motivated his exploration of the close subcontracting relationships used in Japanese manufacturing – which often entailed some subcontractors working closely with assemblers to design and develop customised components – by problematising the extent to which suppliers would be willing to make specialised investments, such as in specialised knowledge and expertise, to service a particular buyer. He argued that suppliers would be reluctant to make relation specific skills investments which effectively become ‘sunk’ unless the relation continues. This exposes the supplier to the risk of ‘hold-up’ by an opportunistic buyer, who may not adequately reward the supplier for their investment, may simply switch to another supplier, or may force the supplier to renegotiate the arrangement in the buyers favour. Gietzmann (1998) also argued that suppliers’ perceived risk of hold-up, and the corresponding underinvestment in relation specific skills, is also likely to be higher in technology related exchanges because the uncertainty of design work and the difficulty in verifying skill

development limits the use of complete, enforceable contracts that reward suppliers for their investments.²⁷

The issue of motivating external parties to make specialised investments also featured in Miller and O'Leary's description of Intel's efforts to convince software vendors to develop complementary improvements in their product offerings in the lead up to the launch of a new microprocessor. Although though this is a downstream, rather than upstream (supplier) relationship, the concern of making firm-specific investments remains (Miller and O'Leary (2005a). As the authors report, "smaller software vendors may be unwilling to invest if they lack confidence in the claims that Intel makes for its future microprocessor generations" (Miller & O'Leary 2005a, p.176).

These studies provide several different indications that cooperation control problems arise in inter-organisational R&D settings. These include the various forms of dependencies that develop as a result of the specialised nature of design and development tasks; the concerns for how to align the interests of autonomous expert external parties; and the challenge of overcoming suppliers concerns of buyer-based opportunism, so that they would be willing to invest in firm-specific competencies.

Despite these indications, these studies vary significantly in their conceptualisation of cooperation control problems and reference to TCE theory. For example, several studies (e.g. Miller, Moll & O'Leary 2012; Miller & O'Leary 2005a; Miller & O'Leary 2005b; Miller & O'Leary 2007; Mouritsen, Hansen & Hansen 2001; Revellino & Mouritsen 2009) do not explicitly consider the existence and management control implications of cooperation issues; however, their empirical results show that cooperation concerns are present in the organisations which they studied. In comparison, the studies by Gietzmann (Gietzmann 1996; Gietzmann & Larsen 1998) use incomplete contracting theory (based on TCE) to focus on the implications of one very specific instance of anticipated opportunism. Finally, Dekker (2004) explicitly uses TCE theory to problematise inter-organisational

²⁷ The non-verifiability of skill investment also presents problems from the buyers' perspective, as they may hesitate on relying on ex ante contracts which commit them to an opportunistic supplier (Gietzmann & Larsen 1998).

‘appropriation concerns’. His case material illustrates several different types of cooperation issues, including dependence concerns and alignment of interest and behaviour. However, these different issues are not considered separately in his conceptual framework, which instead provides a more aggregate formulation of a general potential for opportunism that includes both cooperation and proprietary issues. Taken together, these studies substantiate the existence of various cooperation concerns in inter-organisational R&D; however, there remains scope to focus more closely on cooperation issues and develop a clearer, more systematic specification of the factors which cause cooperation issues to arise in external R&D contexts.

A further issue is that these studies are all focused on product development in commercial settings, which are a specific category of R&D activity. The degree to which cooperation problems translate or correspond to other types of research activities remains to be explored. This may be significant as different types of R&D activities, such as those that do not have a purely commercial imperative or do not contribute towards singular tangible outcomes (e.g. new products), may have different characteristics (e.g. uncertainty and specialisation) that alter the tenor or severity of cooperation control problems.

The following section provides an overview of TCE theory, in order to develop a more systematic consideration of the nature and origins of cooperation control problems, which I then use to frame the emergence of three different cooperation control problems in inter-organisational R&D.

2.3. Understanding the foundations of cooperation control problems

In order to conceptualise the nature and foundation of cooperation control problems, I use theory from organisational economics, specifically TCE theory (Williamson 1971, 1979, 1981, 1985, 1991). Its widespread use in wider academic research notwithstanding²⁸, TCE

²⁸ TCE spans numerous disciplines such as economics, law, organisation science, marketing, sociology, finance, accounting, operations management and agricultural economics; it was recently estimated that approximately 900 empirical articles had been published using TCE (Macher & Richman 2008). David and Han (2004) found that Williamson’s two landmark books (Williamson 1975, 1985) have been cited between 250 and 500 times each year since the early 1990s. As Geyskens, Steenkamp and Kumar (2006, p. 519)

is the dominant lens used by management accounting researchers to study inter-organisational arrangements²⁹, particularly in relation to cooperation control issues (Caglio & Ditillo 2008; Håkansson & Lind 2006; Meira et al. 2010; Neumann 2010; Van der Meer-Kooistra & Vosselman 2006; Vosselman 2012). As Neumann (2010, p.221) explains, TCE “provides the basis for research into opportunism and governance decisions in inter-organizational relations”. In addition, as discussed in the previous section, studies such as Dekker (2004), Gietzmann (1996) and Gietzmann and Larsen (1998) show the applicability of TCE theory to identify the factors which contribute to the cooperation issues specific to the inter-organisational R&D setting.

Although the concept of ‘control problem’ is not used explicitly in TCE, its explanation of why governance structures are needed in contracting provides a useful way to frame cooperation control problems. According to TCE, the reason governance structures are used is to mitigate against the risk that a self-interested party will act opportunistically and take advantage of the other during the course of an exchange (Williamson 1985). Although Williamson, the founder of TCE, does not provide much further specification of the nature of contracting problems (Oxley 1997)³⁰, he provides detailed explication of the antecedent conditions that cause cooperation issues to arise, including behavioural and transactional factors (Williamson 1979, 1985, 1991, 2010).

2.3.1. Behavioural assumptions

According to TCE, ‘serious contractual difficulties’ occur because of the combination of two assumptions about the nature of human behaviour: bounded rationality and opportunism (Williamson 1971, 1985, 1991, 2010). Williamson (1985, p.32) argues that it is the combination of both these two factors that creates the need to “devise contract and

observe, “few other organizational frameworks have been studied for a longer period of time or have been accorded as much scholarly attention as transaction cost theory”. For more comprehensive literature reviews and meta-analysis of the empirical application of TCE in the broader social sciences, see works by David and Han (2004); Geyskens, Steenkamp and Kumar (2006); Joskow (1988); Macher and Richman (2008); Rindfleisch and Heide (1997); Shelanski and Klein (1995).

²⁹ Håkansson and Lind (2006, p. 894) note that “the majority of the published papers within the inter-organizational accounting literature have applied a theoretical framework derived from TCE”.

³⁰ It has largely been left to other TCE researchers to provide detail about specific manifestations of contractual hazards such as ‘hold-up’ or ‘lock-in’ (Joskow 1988; Klein, Crawford & Alchian 1978), ‘appropriation’ (Oxley 1997) or ‘safeguarding’ (Geyskens, Steenkamp & Kumar 2006; Rindfleisch & Heide 1997), and these contributions have not been brought together in a meaningful framework (Williamson 1996).

governance structures that have the purpose and effect of economizing on bounded rationality while simultaneously safeguarding transactions against the hazards of opportunism”.

Bounded rationality

‘Bounded rationality’ (Simon 1957) refers to assumptions about the constraints in humans cognitive ability. That is, despite all intentions to have ‘feasible foresight’ and to act rationally, by their inherent nature human beings cannot know or predict all future contingencies. Thus, peoples’ behaviour is viewed as “intendedly rational, but only limitedly so” (Simon 1957, p. xxiv). Bounded rationality is relevant for TCE because parties that cannot foresee, predict, plan and contract for all possible future contingencies, are forced to use incomplete contracts (Macher & Richman 2008; Williamson 1998).³¹ Bounded rationality does not, however, imply that economic agents are necessarily myopic; although perfectly complete contracting is impossible, “many economic agents have the capacities both to learn and to look ahead, perceive hazards, and factor these back into the contractual relation, thereafter to devise responsive institutions” (Williamson 1996, p.9). Thus, although parties are viewed as boundedly rational, they are assumed to engage in what is referred to as ‘incomplete but farsighted contracting’ (Williamson 1996, p.9).³²

Bounded rationality is the assumption which distinguishes TCE from other contracting theories, such as agency theory, which assumes economic actors are rational (Williamson 1985). If rationality is assumed, then the design of an ex ante contract takes primacy in mitigating contracting hazards as there is no need to provide for ex post adjustment of contracts or the threat of ex post opportunism (Baiman 1990). If, however, transacting parties are boundedly rational, then they cannot plan for all contingencies ex ante, and there is a need for additional safeguards beyond the initial contract. The assumption of bounded rationality thus creates the need for understanding ex post governance.

³¹ Even if perfect planning could be achieved, contracting parties may lack the common language to describe their actions, particularly in areas in which they have little experience. Furthermore, even if contracting parties could plan and negotiate a contract accounting for all contingencies, it would be difficult for them to communicate it in a way that an uninformed third-party arbitrator could interpret and enforce. Thus, virtually all contracts are effectively incomplete (Macher & Richman 2008).

³² Farsighted contracting appears to be an important assumption; without it actors may not anticipate hazards and thus would not attempt to develop mitigating governance mechanisms.

Opportunism

‘Opportunism’ concerns what Herbert Simon called ‘frailties of motive’ (Simon 1957, p.xxiv) and what Williamson referred to as ‘self-interest seeking with guile’ (Williamson 1979, p. 234). In a contracting context, assuming opportunism implies that transacting parties will act in their own self-interest during a contract’s execution to seek advantage for themselves. Significantly, TCE does not assume that *all* people will act opportunistically; instead it assumes that there is the possibility that *some* people will, that it is difficult or costly to predict who, and that trading counterparts will therefore act anticipating the possibility of opportunism (Williamson 1979, 1985).

Opportunism is a significant assumption because without it all transactions, even complex, unpredictable transactions, could be done on promise and there would be no reason to provide extra safeguards to fill the gaps left by incomplete contracts (Barney & Hesterly 2006). As it may be difficult to predict when opportunistic actions will occur, economic actors tend to act conservatively to prevent the possibility, either by ex ante screening efforts or by creating ex post safeguards (Williamson 1985). It is this “attenuating [to] ex post hazards of opportunism through the ex ante choice of governance” that is the primary concern to TCE (Williamson 1998, p. 31).

2.3.2. Transactional characteristics

Assuming the existence of both bounded rationality and opportunism, Williamson proposes that the severity of contracting problems vary on the basis of the nature of the transaction itself (Williamson 1985). Gietzmann (1996, p. 615) quoting Kreps (1990, p.747), explains the significance of transactional characteristics:

Bounded rationality and opportunism don’t come to much when the sort of transaction that is contemplated is something like an exchange of apples for oranges or for money. At least, this is so if we imagine that the buyer of the apples/oranges is sufficiently well versed in these matters to be able to tell the quality of a piece of fruit upon quick inspection. It is the conjunction of the human factors discussed above and various aspects of the specific transaction that lead to significant transaction costs.

Within TCE theory these transactional characteristics are uncertainty, asset specificity and frequency (Williamson 1979, 1981, 1985, 1991).

Uncertainty

Uncertainty refers to the likelihood that unanticipated disturbances or changes will occur, requiring un-programmed adaptations to the transaction (Williamson 2010). These disturbances may originate from several sources, including external turbulence (e.g. market uncertainty, environmental uncertainty, demand uncertainty, supplier uncertainty), behavioural uncertainty, or the unpredictable nature of the transaction itself (e.g. task uncertainty or complexity) (Macher & Richman 2008; Williamson 1998).

The significance of uncertainty is that it exacerbates the problem of bounded rationality in contracting. Higher uncertainty makes it more difficult to predict and plan for all contingencies affecting a transaction, which means that transacting parties need alternative means to ‘adapt’ to emergent changes (Rindfleisch & Heide 1997). This may take the form of writing more comprehensive and costly contracts, or alternatively by developing “a machinery to ‘work things out’” (Williamson 1979, p.254) to compensate for contract incompleteness. Higher uncertainty also creates performance evaluation problems, as it is difficult or costly to verify whether compliance with established agreements has occurred (Williamson 1981).³³ Thus, the overall effect of uncertainty is that it reduces the efficacy of relying on a simple spot contract and creates the need for further governance mechanisms to enable adaptation. In the context of uncertainty, parties are likely to use more comprehensive contracts, alternative means of performance evaluation, or other devices which can enable parties to adapt to new, unforeseen contractual circumstances.

Asset specificity

Asset specificity is a condition describing when “durable investments are undertaken in support of particular transactions, the opportunity cost of which ... is much lower in best alternative uses or by alternative users should the original transaction be prematurely

³³ Williamson (1981) notes the special case of uncertainty that arises in the case of team tasks – as tasks are non-separable it is difficult to assess individuals’ output. This view of uncertainty relates to the Alchian and Demsetz (1972) problem of ‘metering’ or not being able to ex ante measure and anticipate, and thereby contract around output.

terminated” (Williamson 1985, p. 55). A transaction is said to have high asset specificity if it requires suppliers to invest in transaction-specific assets, and these assets cannot be redeployed to alternative uses or users without loss in value (Tadelis & Williamson 2013). It arises in a variety of forms, including: (1) site specificity, where assets are needed to be located at a specific place; (2) physical asset specificity, such as specialised machinery or equipment; (3) human specificity, including specialist knowledge, skills, expertise and learning-by-doing; (4) dedicated assets, such as extra capacity obtained to satisfy the anticipated demand of a particular customer; (5) brand name capital; and (6) episodic or temporal specificity, which relates to the perishability of an asset, or where timing is critical to the transactions’ fulfilment (Williamson 1996). These characteristics generally refer to the nature of the investments made by suppliers (rather than buyers) to support a transaction (Tadelis & Williamson 2013; Williamson 1979).

The significance of asset specificity is that it causes bilateral dependencies to develop between the contracting parties (Williamson 1996). Suppliers are more dependent on buyers because they have invested in assets which cannot be redeployed to alternative uses without significant cost or loss of value, and buyers are more dependent on suppliers because they cannot easily turn to alternative sources who are equally specialised (Williamson 1979, 1985). This degree of dependence may be apparent from the beginning of an exchange or may develop during its course; for example, as the parties gain more relation-specific knowledge and experience in working together (Williamson 1985).³⁴ Because the full benefits of relation-specific investments can only be realised upon the completion of a transaction, the parties are dependent on the continuity of their relationship, making their identities matter, and limiting the efficacy of outside competition in maintaining discipline over the contracting parties (Williamson 1979).

³⁴ Even if at the outset of a contract there are several competing bidders, if the winning supplier needs to make transaction-specific investments, the potential pool of other suppliers who the buyer could switch to at minimal cost to finish the contract becomes limited. This is what is referred to as ‘the fundamental transformation’ of the contracting relationships (Williamson 1985).

Frequency

Transactional frequency refers to the degree a transaction recurs, which ranges from one-time, occasional and recurrent (Williamson 1979), and generally refers to buyer transactional activity (i.e. the degree to which the buyer's transactions recur). Frequency has received substantially less attention within the TCE literature compared to the two other transactional factors (Geyskens, Steenkamp & Kumar 2006; Rindfleisch & Heide 1997; Shelanski & Klein 1995). Perhaps because of this limited attention, the role of frequency in the TCE framework is more ambiguous with at least two different views about its significance in contracting.

The first and more dominant view is that frequency relates to the potential scope of contracting hazards across multiple exchanges and the recoverability of the cost of more specialised³⁵ governance forms (Williamson 1979, 1985). Although it may not be cost-efficient to use specialised, interventionist management infrastructure for occasional or one-off transactions, such a cost may be recovered if spread over recurring transactions (Tadelis & Williamson 2013) or transactions that are similar enough to be aggregated (Williamson 1985).³⁶

An alternative view is that frequency introduces reputation effects, as it creates the possibility that future business is at stake. Suppliers, aware of the value of future transactions, may be less inclined to engage in opportunism; thus for recurring transactions, buyers may be able to use less protected forms of governance (Macher & Richman 2008; Shelanski & Klein 1995; Tadelis & Williamson 2013; Williamson 1998).³⁷

³⁵ In his 1979 paper Williamson indicates that by specialised governance, he means 'relational contracting modes', which are bilateral (hybrid) structures and unified ownership (hierarchical) structures. Less specialised governance forms are market and 'trilateral governance', which is a form of hybrid that has arm's length transactions that are remedied through arbitration rather than courts, and rely on neo-classical law contracting.

³⁶ Williamson (1985) also suggested that the cost of more specialised governance is more easily recovered for large transactions.

³⁷ Occasionally authors use transaction size instead of frequency to proxy for the degree to which future transaction opportunities bond against opportunism (Anderson & Dekker 2005; Dekker 2008).

As these two views generate competing predictions about the relation between frequency and governance structures³⁸, it is perhaps unsurprisingly that Rindfleisch and Heide (1997) observe that TCE researchers have been largely unsuccessful in finding consistent associations between frequency and governance forms. More recently, in their review of the TCE literature, Macher and Richman (2008, p. 7) observe that “empirical researchers have been largely unable to confirm (or refute) the effects of transactional frequency on governance modes”.

2.3.3. Summary

TCE provides a framework for understanding underlying factors which give rise to cooperation control problems between contracting parties. In the context of bounded rationality and opportunism TCE predicts contracting problems to occur due to a combination of asset specificity, uncertainty and frequency. In the following section I will apply TCE’s theoretical framework to build on the conceptual and empirical work of existing studies of inter-organisational control of R&D to propose how various cooperation control problems arise in inter-organisational R&D exchanges.

2.4. The emergence of cooperation control problems in inter-organisational R&D exchanges

In this section, I apply the TCE framework to formulate how cooperation control problems may emerge in inter-organisational R&D exchanges. Similar to the approach used in previous accounting studies, I problematise the control of inter-organisational arrangements by using TCE theory to explain how the characteristics of the external R&D exchange context combine to create the risk of opportunism that needs to be addressed by managers. However, while most previous inter-organisational studies formulate a single aggregate cooperation control problem based on a general risk of opportunism (e.g. Dekker 2004; Johansson & Siverbo 2011; Langfield-Smith 2008; Langfield-Smith & Smith 2003; Speklé 2001; Van der Meer-Kooistra & Vosselman 2000), I propose that there may be several different types of cooperation issues which emerge in inter-organisational exchanges.

³⁸ The recoverability approach suggests high frequency will be associated with greater reliance on hierarchical governance whereas the reputation approach predicts high frequency to cause less reliance on hierarchical forms.

There are two reasons why taking this more disaggregated approach towards cooperation control problems appears appropriate. First, different forms of opportunism are likely to alter the nature of cooperation control problems. Williamson (1985) acknowledges that opportunism describes a wide range of self-interested behaviours, including “but scarcely limited to more blatant forms, such as lying, stealing and cheating” as well as “more subtle forms of deceit” and “incomplete or distorted disclosure of information, especially to calculated efforts to mislead, distort, obfuscate, or otherwise confuse” (Williamson 1985, p.47). Neumann (2010) argues for a more differentiated view of opportunism, distinguishing between efforts to take advantage of specialised investments through hold-up, deliberate ex ante misrepresentation, and ex post violation of formal contracts, through shirking or hidden information. As she explains:

...although these kinds of opportunism might not always be interpreted as distinct manifestations of opportunistic behavior, this can vary and different governance mechanisms are needed to safeguard the IOR [inter-organizational relation] (Neumann 2010, p.221).

This leads us to the second reason for differentiating between types of control problems – that different types of cooperation control problems may require alternative control solutions. For example, Neumann (2010) demonstrates in her case study that organisations design and implement a variety of control strategies when anticipating different types of opportunistic behaviour.³⁹ This aligns with empirical observations in the inter-organisational R&D setting by Revellino and Mouritsen (2009) who find that the nature of ‘control challenges’, as well as their managerial responses, vary throughout the course of an R&D project.

Furthermore, even though previous studies in the inter-organisational control literature formulate a single aggregate cooperation control problem, researchers often associate the use of specific control mechanisms with different stages of a transaction or relationship. For example, Neumann (2010) and Dekker (2004) distinguish between the control strategies

³⁹ For example, she concludes that “many of the formal mechanisms in this IOR were implemented to safeguard specific investments. Yet the results also indicate that opportunistic behavior can vary. Shirking and information misrepresentation play a vital role in ex ante governance decisions” (Neumann 2010, p.234).

exerted at the *ex ante* and *ex post* stages of relation; Van der Meer-Kooistra and Vosselman (2000, p. 54) suggest that “decisions about the structuring of inter-firm management control systems concern three phases of a transactional relation: a contact phase, a contract phase and an execution phase”. Their three-phase model of MCS has been adopted by several later studies (e.g. Donada & Nogatchewsky 2006; Johansson & Siverbo 2011; Nicholson, Jones & Espenlaub 2006) who confirm the use of different control solutions at different phases.

Although it is feasible that different controls may be used to address the same underlying problem, the variation of control solutions may also reflect the need to address different control problems arising at different stages of a transaction. Thus, by taking a more disaggregated formulation of cooperation control problems I may be able to develop a more nuanced understanding of the specific relations between particular types of control solutions and types of cooperation problems.

In order to structure my analysis of the variants of control problems within the cooperation category, I follow previous studies by proposing that different cooperation control problems may arise at different stages of an R&D exchange. To categorise these stages I use the phases of contracting from Van der Meer-Kooistra and Vosselman (2000): the *ex ante* development of the R&D project, the investment decision at the point of *contract*, and the *ex post* execution and fulfilment of the contract.

2.4.1. The negotiation of mutually-satisfying project contracts

The first stage when difficulties may occur is at the beginning of the R&D process – as the project is being developed. At this stage, parties are faced with the challenge of negotiating a mutually satisfying R&D project. From the funders’ perspective, this requires sourcing and negotiating with providers, to develop a project contract which delivers the outcomes required by the funder, yet also constitutes a project contract that R&D providers are willing to complete.

Project negotiations may be prone to cooperation issues for a number of reasons. First, the parties may have different expectations of the R&D exchange. Funders and providers may differ in their expectations regarding various project parameters, including its strategic

direction, topic, outcomes, objectives, time frame, method, degree of risk, or resource requirements. As explained previously, the divergence of interests is likely to be exacerbated by the inter-organisational setting due to the specialisation of parties⁴⁰ and lack of a common ownership structure. This has been observed in prior studies where the development stages of R&D are characterised by “a multiplicity of heterogeneous and often confused decisions made by a large number of different and often conflicting groups, decisions which one is unable to decide a priori as to whether they are crucial or not” (Akrich, Callon & Latour 2002, p.191). In addition, while internal parties are subject to managerial fiat – meaning that managers may either force parties to compromise or even set the project parameters themselves – external contract parties retain the ability to walk away.

The negotiation phase of R&D exchanges is also complicated by the inherent idiosyncrasy or asset specificity of R&D transactions. The specialisation of externally contracted R&D projects is driven by the specificity of the funder’s needs for technology. For example, in the case of commercial product development, external suppliers need to deliver technology that addresses the functional requirements of customers (Dekker 2004; Mouritsen, Hansen & Hansen 2001), or technology that fits with existing components, support systems or product offerings (Miller & O’Leary 2005a; Revellino & Mouritsen 2009). Even in less restrictive R&D environments, such as the awarding of competitive grants for public research, funders may still express preference for projects tailored towards their particular research priorities or salient problems in the funder’s context. Funder needs for specialised research projects means that external suppliers may be required to make funder-specific investments, for example by developing particular skills or knowledge, acquiring specific equipment or facilities, re-locating for field work, or developing working relations with funder personnel or other providers. This condition of asset specificity creates bilateral dependencies between parties, causing at least two problems in project negotiation.

First, from the funder’s perspective asset specificity limits the pool of available providers who have requisite capabilities to do the project, which not only increases the funders’

⁴⁰ R&D exchange parties may include industry funders seeking commercial outcomes, government bodies that fund R&D to generate ‘public goods’, and research providers who pursue funding opportunities to further their own career or scientific outcomes.

search costs, but also reduces supplier competition as a discipline device, exposing the funder to the risk of opportunistic hold-up in negotiations (Joskow 1988). A specialised technology provider may exploit the funder's lack of alternatives to bargain for more favourable terms, which becomes costly to the funder if they agree to less favourable terms or engage in a more protracted negotiation phase. This risk of negotiation hold-up is exacerbated in situations where the funder has recurrent technology needs. Suppliers with whom funders have contracted with previously have inherent advantages compared to others, which over time creates a growing dependency as certain providers develop relation-specific capabilities that become harder for the funder to replace (Dekker 2004; Donada & Nogatchewsky 2006; Langfield-Smith 2008; Langfield-Smith & Smith 2003; Van der Meer-Kooistra & Vosselman 2000).

An alternative problem is that technology providers may be unwilling to agree to highly specialised project contracts in the first place, if it requires them to make funder-specific investments that have little transferability or value in other R&D exchanges (Gietzmann 1996; Gietzmann & Larsen 1998). Seen through the supplier's perspective, asset specificity can create unwanted buyer-dependence; once they have made funder-specific investments for a transaction, it in effect becomes a sunk cost as the value of the investment can only be realised with the completion of the contract – this then exposes the supplier to buyer opportunism (Dekker 2004).

For example, in studies examining the outsourcing of development work by auto-assemblers to subcomponent subcontractors, researchers argued that subcontractors would be wary of engaging in transactions that required the investment in specialised equipment because it exposed them to the risk that the assembler would opportunistically 'hold them up' by offering poor contractual terms or engaging in opportunistic renegotiation (Anderson, Glenn & Sedatole 2000; Gietzmann 1996; Gietzmann & Larsen 1998). As Gietzmann (1996, p.615) explained, this could occur "because the assembler knows that after making the asset investment, the subcontractor is now locked into the relationship given that (dedicated) assets have little or no value in other relationships". Furthermore, suppliers may anticipate an even greater risk of buyer opportunism when contracting technological development, because the uncertain nature of design process limits the

completeness of contracts that reward and protect suppliers for making relation-specific investments (Anderson, Glenn & Sedatole 2000). If providers anticipate buyer opportunism, they may be reluctant to engage in specialised R&D contracts, particularly if the transaction has low likelihood of recurrence. This is costly to the funder because they may need to offer more favourable terms to entice the provider or to invest in further safeguards to assure the exchange.

Funders are therefore confronted with several different problems at the negotiation phase, arising out of a combination of divergent party interests, high asset specificity, low frequency and high uncertainty. The potential dysfunctional consequences of these problems include the additional search costs associated with finding providers willing to invest in specialised capabilities required for an R&D project, as well as exposure to negotiation hold-up by providers upon which the funder is dependent.

2.4.2. Making project investment decisions

The second stage when cooperation problems may occur is at the point of contract, when decisions are made about the projects selected for investment. In many different organisational contexts the inception of a project requires an investment decision to be made under conditions of uncertainty (Langfield-Smith & Smith 2003). In the case of R&D projects, even in projects initiated and executed by a sole individual, boundedly rational decision-makers commit resources towards an activity without certainty about the nature, timing or value of the outcomes that may eventuate (Abernethy & Brownell 1997; Davila 2000; Jørgensen & Messner 2010; Rockness & Shields 1984, 1988).

When exchanges involve the commitment of resources by parties other than the researcher (e.g. R&D managers, senior managers, seed funders), the investment decision also involves varying degrees of information asymmetry between the funder and the researcher about the capabilities of the researcher and the exact nature of the technical aspects of the project (Davila 2000; Den Hertog & Roberts 1992; Ditillo 2004; Jørgensen & Messner 2010). For external exchanges, this information asymmetry is likely to be larger as the funder may not be specialised in the science, may not be familiar with the provider, or otherwise may suffer from informational problems arising from lack of proximity (Nicholson, Jones &

Espenlaub 2006).⁴¹ Furthermore, because R&D projects are often idiosyncratic there are no comparable benchmarks, as there are for more standardised goods, making it difficult for funders to value alternative proposals. R&D projects therefore appear to be characterised by ‘low contractibility’ – a combination of low measurability of outputs, poor knowledge about the production process, and high asset specificity – making it difficult to specify complete contracts and therefore ‘difficult to govern’ (Johansson & Siverbo 2011, p.293).

Informational problems may create opportunities for providers to deliberately misrepresent their own capabilities or intentions (Neumann 2010). For example, a provider may opportunistically overstate their own abilities or the intended project objectives, which the funder is unable to detect, in order to win the contract. Furthermore, they may do so anticipating future opportunities to exploit emergent uncertainties, funder-dependence or further information asymmetry, in order to adjust the project scope to suit their own interests. From a funder’s perspective, at the time of the contract, they thus may face the risk of making poor investment decisions (Neumann 2010).

2.4.3. Ensuring compliance with project contracts

After the contract is awarded, R&D funders may face difficulties in ensuring the providers comply with their contractual obligations for the project. In these ex post stages, there is the risk that providers will act opportunistically, for example, by shirking effort to concentrate on other activities or altering the project to address their own career or scientific objectives.

The potential for ex post opportunism arises from the incomplete nature of R&D project contracts, which makes it difficult to specify, monitor, control and enforce what exactly constitutes satisfactory contract completion for development activities (Anderson, Glenn & Sedatole 2000; Balakrishnan et al. 2010; Dekker 2004; Neumann 2010). Providers can exploit this incompleteness, particularly in the context of either unanticipated contingencies

⁴¹ Nicholson, Jones and Espenlaub (2006) problematise the offshoring of accounting and finance activities by UK firms to India, arguing that the information asymmetry arising from geographical and cultural differences between the parties gives rise “to a range of potentially insurmountable difficulties arising from informational problems, incentive conflicts, the potential for opportunism, and uncertainty aggravated by the stretching of the exchange relationship across two widely differing institutional frameworks...[and] according to TCE, the offshore outsourcing of much of the AF [accounting and finance] function may be expected to be thwarted by the presence of prohibitive transaction costs”.

(e.g. unexpected technical problems) or ex post information asymmetry which both constrain a funder's ability to distinguish opportunism from legitimate deviations from the contract (Speklé 2001).⁴² This particular contracting issue has been reported in studies of outsourced IT transactions (Anderson & Dekker 2005; Dekker 2008) where uncertainty in specifying the desired outcomes, information asymmetry between the buyer and seller, and difficulties in monitoring progress and outcomes, has made it "difficult to assign blame in the event of system failure, attenuating the motivation of each party to fulfil obligations" (Anderson & Dekker 2005, p.1737).

In addition, as projects progress, suppliers gain significant asset-specificity advantages compared to other research providers, making it difficult or costly for the funder to terminate the project or switch providers ex post. In such situations, funders could face the risk of ex post hold-up, such as when a provider insists on adjusting the project parameters or opportunistically demands further resources or time to complete the project (Anderson, Glenn & Sedatole 2000). These issues are likely to be more severe in external R&D exchanges because the information asymmetry between funder and provider is more pronounced, and it is more difficult for the funder to monitor or control the provider's activities.

2.4.4. Summary of cooperation control problems

There may be several different cooperation control problems that emerge during the course of an inter-organisational R&D exchange. As summarised in Table 1 below, organisations may face a variety of cooperation issues at successive contracting phases, including the costly negotiation of mutually agreeable project contracts ex ante to an exchange; the risk of poor project investment decisions as a result of suppliers' misrepresentation about their capabilities and the parameters of the project at the time of contract; and the difficulties in ensuring suppliers comply with the contract ex post, given incomplete contracts, dependence, uncertainty and information asymmetry.

⁴² Speklé (2001) refers to this type of information asymmetry as 'post hoc information impactedness'; during the course of transactions involving non-programmable activities, one party (typically the supplier) gains an information advantage over the other.

Table 1: Summary of cooperation control problems in R&D exchanges

Phase	Ex ante	Contract	Ex post
Cooperation control problem	Costly set-up and negotiation of projects	Poor project investment decisions	Difficulty in evaluating and enforcing contract compliance
Potential opportunism	Hold-up	Misrepresentation	Hold-up; shirking; misrepresentation
Contributing factors	Divergence of party interests; dependence on specialised suppliers; suppliers willingness to become specialised	Task uncertainty about R&D outcomes; ex ante information asymmetry between funders and providers; idiosyncrasy of R&D projects	Incompleteness of contracts; asset specificity; ex post information asymmetry between funders and providers

2.5. Chapter summary

In this chapter I have drawn upon existing literature to develop an understanding of how cooperation control problems arise in inter-organisational R&D exchanges. As discussed in Section 2.2, the inter-organisational environment alters the context of management control as it changes the focal subject of control from operational activities performed by in-house employees to discrete ‘R&D exchanges’ with external contractors; it introduces greater divergence of interests; and it reduces the capacity to enact traditional hierarchical forms of control. Thus the inter-organisational setting creates different imperatives for the management control of R&D. The particular category of control problem I focus on is ‘cooperation’, which refers to the need to ensure that autonomous trading counterparts do not act opportunistically. To develop a more systematic understanding of cooperation control problems I draw on theory from TCE (outlined in Section 2.3), which explains the behavioural and transactional factors that give rise to the risk of opportunism in contracting situations. Following the conjecture from Neumann (2010) that different types of opportunism create different cooperation problems, in Section 2.4 I use TCE to formulate three types of cooperation control problems that may occur at different phases of an inter-organisational R&D exchange. These problems are: the costly negotiation of mutually agreeable project contracts ex ante to an exchange; the risk of poor project investment decisions as a result of suppliers’ misrepresentation about their capabilities and the parameters of the project at the time of contract; and the difficulties in ensuring suppliers comply with the contract ex post, given incomplete contracts, dependence, uncertainty and information asymmetry. In the next chapter, I review existing literature to conceptualise the potential control solutions to these cooperation control problems.

Chapter 3: Control solutions to cooperation problems in inter-organisational R&D

3.1. Introduction

The aim of this chapter is to develop a preliminary understanding of the nature of potential control solutions found in inter-organisational R&D arrangements. My starting point is the broader body of management control literature which has used TCE theory to frame studies of how organisations respond to cooperation control problems in inter-organisational arrangements. The review of this body of work in Section 3.2 shows a variety of control solution conceptualisations, including the choice of governance structure and the choice of MCS. In the subsequent sections I then explore the nature of these two choices in greater detail and in the context of R&D. In Section 3.3 I explore the nature, control capacity and types of hybrid governance structures. This is followed by a review of the MCS likely to be found within hybrid arrangements in Section 3.4.

3.2. Management control of inter-organisational arrangements

Numerous accounting scholars have used TCE to explore the structuring, managing and controlling of cooperation problems in inter-organisational arrangements.⁴³ This section provides an overview of the basic TCE explanation for why various control solutions address cooperation problems, and second, of the types of control solutions examined by inter-organisational control research.

Many studies of inter-organisational control are built upon TCE's central argument that there are "alternative ways of organizing relationships among economic units in order to take advantage of the division of labor while economizing on bounded rationality and safeguarding parties against contractual hazards" (Ménard & Shirley 2005, p.282). More simply, TCE theory explains that the choice of control solutions depends on the severity of

⁴³ Accounting researchers have also used TCE to study intra-organisational implications of cooperation issues that occur within hierarchies (e.g. Baiman 1990; Colbert & Spicer 1995; Spicer 1988; Spicer & Ballew 1983; Swieringa & Waterhouse 1982; van der Meer-Kooistra 1994; Widener 2004); however, this research lies outside the scope of this thesis.

contractual hazards, such as the risk of opportunism, arising out of the combination of transactional and behavioural factors (described in Chapter 2). TCE's founder, Oliver Williamson, argued that the solution to contractual hazards resided in the choice of governance mode that transactions were administered within⁴⁴ (Williamson 1991). Following Coase (1937, 1960), Williamson initially conceptualised the choice of governance mode as between the market and the hierarchy – the two alternatives in the 'make or buy decision' (Williamson 1971); he subsequently extended the theory to include a third alternative – 'the hybrid' (Williamson 1985, 1991). Each of the three types of governance are attributed with different capabilities, strengths and limitations that are more or less efficient in handling contractual problems produced by the different types of transactions (Williamson 1991, 1996, 2008).

TCE predicts a match between governance modes and transactions using the 'efficient alignment hypothesis' (Tadelis & Williamson 2013; Williamson 1998, 2010): we expect an alignment between "transactions, which differ in their attributes, with governance structures, which differ in their costs and competencies, in a discriminating (mainly, transaction cost economizing) way" (Williamson 1991, p. 79). The emphasis on 'transaction-cost economizing' means that the governance structure chosen will be the arrangement that offers sufficient protection from the hazards of contracting, at the lowest cost. As Macher and Richman (2008, p. 5) explain:

...complex modes of organization are reserved for complex transactions, to which contractual hazards accrue; whereas simple modes of governance suffice for simple transactions, of which the ideal transaction in both law and economics are those for which identity does not matter. To use a simple mode of governance to manage a complex transaction would be to risk contractual breakdown, whereas to use a complex mode of governance to manage a simple transaction would be to incur additional costs without significant gain.

The studies which have applied TCE theory to explain the management control of inter-organisational arrangements are summarised in the table in Appendix A. As this table

⁴⁴ Also referred to 'institutional structures of production', 'mechanisms of governance', 'modes of organisation' and 'governance structures' (Ménard & Shirley 2005).

shows, this collection of studies is highly diverse, with authors examining a variety of empirical settings, including hospitals (Balakrishnan et al. 2010; Roodhooft & Warlop 1999); sugar cane production (Sartorius & Kirsten 2005); car manufacture and assembly (Anderson, Glenn & Sedatole 2000; Gietzmann 1996; Gietzmann & Larsen 1998); accounting, finance and audit services (Nicholson, Jones & Espenlaub 2006; Speklé, van Elten & Kruis 2007; Widener & Selto 1999); industrial maintenance and shared services (Van der Meer-Kooistra & Vosselman 2000; Vosselman 2002); information technology (Anderson & Dekker 2005; Dekker 2008; Langfield-Smith & Smith 2003); railway equipment (Dekker 2004); construction (Langfield-Smith 2008); airlines (Neumann 2010); and the public sector (Johansson & Siverbo 2011).

They have also used a range of investigative methods. These include qualitative methods within single case studies (e.g. Dekker 2004; Langfield-Smith & Smith 2003; Neumann 2010) and comparative case studies (e.g. Donada & Nogatchewsky 2006; Van der Meer-Kooistra & Vosselman 2000). Several authors also use more quantitative methods to capture cross-sectional variation in control practices through surveys or use of archival databases that have recorded series of transactions (e.g. Anderson & Dekker 2005; Dekker 2008; Johansson & Siverbo 2011; Phua, Abernethy & Lillis 2011).

This body of work is also diverse in terms of the types of control solutions researchers have studied in response to cooperation control problems in inter-organisational arrangements. As other reviewers of this research area have observed, different management control researchers have conceived of control solutions at varying levels of analysis (Anderson & Dekker 2010) or breadths of scope (Caglio & Ditillo 2008). These conceptualisations range from entire governance structures, MCS configurations, and individual management mechanisms, as well as the terms embedded within transactional contracts. The variety of control solution conceptualisation has been driven by differences in how researchers use TCE theory to conceive of control solutions to cooperation problems. In the following subsections I will briefly describe two different approaches which have led to alternative

conceptions of control solutions as either the choice of *governance structure* or the choice of *MCS* embedded within governance structures.⁴⁵

3.2.1. Choice of governance structure

Several accounting researchers apply TCE theory quite literally, arguing that control solutions reside in the choice of governance structure. These researchers include, for example, those who have examined the ‘make-or-buy’ decision by measuring the propensity to organise certain transactions internally within hierarchical structures or externally through some sort of market procurement (e.g. Anderson, Glenn & Sedatole 2000; Balakrishnan et al. 2010; Roodhooft & Warlop 1999; Speklé, van Elten & Kruis 2007; Widener & Selto 1999). Their results confirm TCE’s prediction that transactions with higher cooperation hazards (i.e. high asset specificity, uncertainty and frequency) tend to be administered through hierarchy rather than market governance.⁴⁶ Some studies have also considered a more extended decision to ‘make-buy-or-ally’ (Anderson & Dekker 2010), in which hybrids are modelled as a governance alternative for addressing moderate cooperation hazards (e.g. Sartorius & Kirsten 2005; Speklé 2001; Vosselman 2002).

Another collection of studies, using more exploratory empirical approaches, have investigated the nature of alternative outsourcing arrangements that differ from pure market procurement (e.g. Cooper & Slagmulder 2004; Gietzmann 1996; Nicholson, Jones & Espenlaub 2006; van den Bogaard & Speklé 2003). For example, Gietzmann (1996) and Cooper and Slagmulder (2004) study the contracting arrangements within Japanese subcontracting arrangements, characterised by the establishment of long-standing relations with particular suppliers, which are regulated by a variety of incentives, monitoring, social and procedural control mechanisms. This collection of studies show hybrids’ capacity to

⁴⁵ It is beyond the scope of this chapter to review the studies in Appendix A individually; however, readers are directed to several existing reviews of TCE inter-organisational control literature (e.g. Anderson & Dekker 2010; Caglio & Ditillo 2008; Håkansson, Kraus & Lind 2010; Håkansson & Lind 2006; Meira et al. 2010; Van der Meer-Kooistra & Vosselman 2006; Vosselman 2012).

⁴⁶ For example, Widener and Selto (1999) and Speklé, van Elten and Kruis (2007) predict the likelihood of outsourcing internal auditing activities on the basis of asset specificity, uncertainty and frequency. Similar approaches have been used to explain the degree of outsourcing in hospital services (Balakrishnan et al. 2010; Roodhooft & Warlop 1999); auto manufacturing (Anderson, Glenn & Sedatole 2000); centralised support services (Vosselman 2002); and sugar cane production (Sartorius & Kirsten 2005). The results of these studies generally confirm TCE theory – transactional attributes, especially asset specificity, appear to drive governance choice.

enact control through different structures and mechanisms, and also that hybrids are able to facilitate inter-organisational exchanges even in the context of substantial cooperation hazards arising out of high asset specificity (Anderson, Glenn & Sedatole 2000; Nicholson, Jones & Espenlaub 2006; van den Bogaard & Speklé 2003).

3.2.2. Choice of management control systems

Many studies listed in Appendix A conceptualise the control solutions to cooperation problems in terms of the *choice of MCS* embedded within an inter-organisational arrangement. Authors of these studies appear to use TCE analogically, arguing that MCS are equivalent to ‘governance mechanisms’ (Langfield-Smith & Smith 2003; Van der Meer-Kooistra & Vosselman 2000). They propose that the choice of these mechanisms will follow the same logic used to determine the choice of governance structure: that is, MCS is expected to vary dependent on the severity of cooperation hazards produced by different transactional factors.

There is substantial diversity in how researchers define inter-organisational MCS (Anderson & Dekker 2010; Caglio & Ditillo 2008). For example, some researchers conceive control choices in terms of *patterns of control*. The most well-known example is perhaps the Van der Meer-Kooistra and Vosselman (2000) framework which differentiates between market, bureaucracy and trust based-based patterns of control, which are expected to align, respectively, to transactions ranging from low to high cooperation hazards. At a level below broad patterns, other researchers conceive of control choices in terms of the *categories of mechanisms*, such as social, action or outcome-based controls (e.g. Dekker 2004; Johansson & Siverbo 2011), or exploratory, boundary or machine controls (Nicholson, Jones & Espenlaub 2006; Speklé 2001). Alternatively, some researchers have investigated the use of specific types of mechanisms, including trust, partner selection, and ex ante or ex post control practices (e.g. Dekker 2008; Langfield-Smith 2008; Langfield-Smith & Smith 2003; Neumann 2010). At the most detailed level, researchers conceive of management control in terms of the *inter-organisational contract*, showing that cooperation hazards are associated with variations in the extensiveness or structure of contracts (e.g. Anderson & Dekker 2005; Birnberg 1998; Dekker 2008).

3.2.1. Summary

Collectively, the inter-organisational management control research indicates that there may be various ways to respond to cooperation control problems, including the nature of the governance structure and the types or combinations MCS. In the following two sections I will explore the choice of hybrid governance structures and choice of MCS more closely, seeking to complement the inter-organisational management control research with developments from broader economic literature about hybrids, and empirical observations from inter-organisational R&D studies.

3.3. Hybrid governance structures

The aim of this section is to explore the nature, control capacity and types of hybrid structures in addressing cooperation control problems in inter-organisational R&D. Although some previous inter-organisational management control studies have explored various aspects of hybrid governance (e.g. Cooper & Slagmulder 2004; Gietzmann 1996; Nicholson, Jones & Espenlaub 2006; Sartorius & Kirsten 2005; Speklé 2001; van den Bogaard & Speklé 2003; Vosselman 2002), overall there remains a lack of consistency in the way accounting researchers have approached the capacity and variety of hybrid governance structures as control solutions to cooperation control problems. In this section, I will first describe this issue in more detail, before introducing conceptual developments from recent economic literature that provides a more systematic understanding of the characteristics, structural governance capacities, and variation of hybrid forms. Finally, I relate the conceptual features of hybrids to empirical observations of inter-organisational R&D arrangements found in practice.

3.3.1. Limitations of hybrid conceptions in management control research

There have been various attempts by management control researchers to explore and explain the control capacity of hybrid governance structures in relation to cooperation problems; however, there appear to be at least three limitations in how hybrids have generally been conceived in this body of research.

First, the inter-organisational management control studies listed in Appendix A hold varying conceptualisations of what constitutes hybrid governance. For example, many researchers equate hybrids, quite simply as ‘inter-organisational relationships’ (Caglio & Ditillo 2008; Van der Meer-Kooistra & Vosselman 2000), which are recognised broadly as inter-organisational arrangements that have more safeguards than arm’s length contracting in markets.

Second, it appears that this body of research has investigated only a limited subset of hybrid arrangements. The vast majority have studied dyadic exchanges between two parties, a buyer and a supplier, with only a handful of studies examining cooperation control issues in more complex network forms, such as a bi-lateral code-sharing strategic alliance between two airlines (Neumann 2010); the involvement of two parents in the creation of a new entity, such as a joint venture (Dekker 2004; Kamminga & Van der Meer-Kooistra 2007); or the formation of a strategic alliance with a consortium of providers (Langfield-Smith 2008). This means there has also been an overrepresentation of some types of hybrid arrangements, with the vast majority of studies having examined either short-term outsourcing or longer-term subcontracting relationships (with the exception of studies such as Kamminga & Van der Meer-Kooistra 2007; van den Bogaard & Speklé 2003).

The underrepresentation of alternative hybrid forms is significant, as there is some evidence that the type of MCS varies with the type of arrangement. For example, Cooper and Slagmulder (2004) show that different types of ‘relational contexts’ influence the types of inter-organisational cost management practices used in external product design transactions. More specifically, they found that more intensive practices that supported high levels of design changes, (e.g. concurrent cost management initiatives and inter-organisational cost investigations) occurred in hybrids with more intense relational contexts (e.g. between parties that were family members or a major supplier), whereas less intensive techniques (e.g. functionality–price–quality trade-offs) were used in more arm’s length subcontracting situations. Their results indicate the type of hybrid is significant in understanding what MCS may be used.

Furthermore, the studies which do consider different types of hybrids generally only conceive of a limited range of different hybrid forms. For example, Speklé 's (2001) taxonomy of nine different 'management control system archetypes' identifies only two types of hybrids (one relying on arm's length control and another on exploratory control). Sartorius and Kirsten (2005) consider five different governance possibilities for how firms could organise sugarcane production; only three – specification contract, strategic alliance, formal cooperation – represent hybrids.

In both these examples, the lack of diversity in hybrid types is likely because these models were built to accommodate *all* governance categories, including market and bureaucracy, which means that less attention is given to the within category variation that may exist between hybrids. The difficulty in using broad classifications of 'ideal types' of hybrids is that they may not be sufficient to differentiate hybrid forms found in practice (Nicholson, Jones & Espenlaub 2006). Furthermore, there is a danger that without reference to a more systematic way of classifying hybrids, empirical research – which has often been single or dual case studies – will lead to a piecemeal understanding of hybrid forms. For example, several researchers have studied non-equity long-term outsourcing arrangements between a single buyer and supplier; however, these have been variously labelled as 'buyers-supplier relationships' (Donada & Nogatchewsky 2006), 'inter-organisational relationships' (Van der Meer-Kooistra & Vosselman 2000), 'strategic alliances' (Dekker 2004; Langfield-Smith & Smith 2003), and 'relational contracts' (Cooper & Slagmulder 2004). Adding further confusion, these arrangements are substantively different from other forms labelled as 'strategic alliance', such as the bi-lateral agreement studied by Neumann (2010) and the subcontracting arrangement with a consortium in Langfield-Smith (2008).

Third, there are inconsistencies in researchers' acknowledgement of the 'control-solving capacity' of hybrid governance structures. Some studies position hybrid structures as a control solution to cooperation problems (e.g. Cooper & Slagmulder 2004; Sartorius & Kirsten 2005; Vosselman 2002); however, others tend to overlook the role of hybrid governance structures as a first-order control solution, instead treating hybrids as the context in which cooperation problems are addressed by different patterns of MCS (e.g. Dekker 2004; Langfield-Smith & Smith 2003; Van der Meer-Kooistra & Vosselman 2000).

This is because the focus of the majority of these studies has been to explain variation in MCS; meaning that often the control enacted by the hybrid itself as a secondary concern. That is, they use TCE theory to specify frameworks which predict the differential use of MCS within all generic types of inter-organisational relationships, and thus tend to overlook or downplay the significance of the hybrid governance structure as a first-order control solution.

To provide a more systematic approach to hybrids, in the following sections I introduce developments from recent economic literature that provide an understanding of the characteristics of hybrid forms as well as the structural dimensions that describe their governance capacities and variation.

3.3.2. Characterising hybrids

In economic literature, hybrids⁴⁷ are defined as organisational arrangements:

...in which two or more⁴⁸ partners pool strategic decision rights as well as some property rights while simultaneously keeping distinct ownership over key assets, so that they require specific devices to coordinate their joint activities and arbitrate the allocation of payoffs.
(Ménard 2013, p.1066)

The basic case for hybrids is that, compared to more market forms of inter-organisational exchanges, they offer more safeguards to opportunism by parties⁴⁹:

⁴⁷ The term ‘hybrid’ is typically used in Coase-Williamson economics; however, these organisational forms have also been widely studied in sociology and management literature under different guises such as ‘alliances’, ‘networks’, ‘clans’, symbiotic arrangements’ (Ménard 2013). For reviews of this extended body of work see Grandori and Soda (1995) and Oliver and Ebers (1998).

⁴⁸ Hybrids can be both bilateral and multilateral arrangements (Oxley 1997).

⁴⁹ Markets, which are characterised by arm’s length exchanges based on simple price contracts, are highly efficient in handling ‘simple transactions’. This is because low uncertainty allows for more complete contracts that can be externally enforced (Williamson 1979) and low asset specificity reduces the risk of opportunism, making the existence large numbers of competing suppliers sufficient to police behaviour (Riordan & Williamson 1985; Tadelis & Williamson 2013; Williamson 1979, 1985, 1991). In fact, given low asset specificity, markets can also handle transactions of higher uncertainty: in the event of some sort of disturbance there is still a competitive market of potential suppliers from which a buyer could easily switch to. However, because transacting parties retain complete autonomy, there are limited opportunities to exert control over recalcitrant parties, which is particularly problematic for idiosyncratic transactions that reduce the discipline of large-number competition (Williamson 1979, 1991, 1996).

The underlying idea is that when investments among partners are specific enough to generate substantial contractual hazards without justifying integration and its burdens, and when uncertainties are consequential enough to require tighter coordination than what markets can provide, parties have an incentive to choose hybrids. (Williamson 1991, p.31)

The most fundamental characteristic of hybrids that distinguishes them from markets is the pooling of resources (Ménard 2004). Resource pooling occurs when parties contribute to joint investments or when each makes individual investments that join together in a complementary, interdependent network (Ménard 2006). Parties are likely to pool resources to create additional value, such as increased market opportunities, a sharing of complementary skills and knowledge or access to scarce resources, or alternatively to buffer against external volatility, turbulence or technological change (Ménard 2013). Resource pooling creates the need for collective planning, joint investment decision-making, and some form of central coordination or cooperation. Also, because it creates interdependence between the parties, their identities matter, which is why hybrids are typically characterised as selective rather than open systems (Grandori & Soda 1995).

Another feature of hybrid governance, which distinguishes it from hierarchy, is that the parties are autonomous entities that are not integrated within a common ownership structure (Ménard 2006). To varying extents, parties retain ownership of other non-related assets, decision rights over their own operations, and ultimate property rights, which makes sharing of the collective gains and residual assets a significant, and often contentious issue (Ménard 2004). As a consequence, although partners cooperate within the bounds of a hybrid arrangement, they can also be in competition with one another⁵⁰, creating situations of ‘coopetition’ (Ménard 2013). Also, different hybrid arrangements often compete against each other in the same market, creating opportunities for autonomous parties to switch allegiances (Ménard 2004). The result of these varying competitive pressures is that hybrid

⁵⁰ Competition may be an integral part of some hybrids, such as recurrent bidding competition in sub-contacting, or it may arise from a shared geographical location (e.g. for members who are housed in a common technology park or precinct) or common markets. In other situations, hybrid parties may cooperate on some activities whilst compete on others, e.g. in strategic alliances in airlines, pharmaceutical, and biotech industries (Ménard 2004).

participants may confront significant conflicts of interest and incentive issues (Ménard 2013).

3.3.3. The structural dimensions of hybrid structures

The pooling of specialised assets and mix of competition and cooperation exposes hybrid parties to the risk of opportunistic behaviour, which cannot be mitigated through either price or hierarchical command (Geyskens, Steenkamp & Kumar 2006; Ménard 2013; Rindfleisch & Heide 1997). Instead, various contributions in economic literature indicate that hybrids rely on alternative structures and mechanisms to enact governance (Geyskens, Steenkamp & Kumar 2006; Joskow 1988; Ménard 2004, 2006, 2013; Rindfleisch & Heide 1997; Shelanski & Klein 1995; Williamson 1979, 1983, 1996). Although these features have often been studied in isolation from one another, and labelled with different constructs, they appear to cluster around certain categories or structural dimensions (Ménard 2013), such as centralisation; formalisation; and relational governance⁵¹.

Centralisation

Hybrids mitigate cooperation issues through different forms of centralisation, including the centralisation of property and decision rights over pooled assets, and centralisation of monitoring, controlling or coordinating partners (Ménard 2013).

The pooling of assets is fundamental to the decision to ‘go hybrid’ and the specificity of those assets creates mutual dependence between the partners (Ménard 2004). Mutual dependence can be managed through the centralisation of property rights of pooled assets which can vary from offers of ‘credible commitments’, such as an equity swaps or ‘hostage arrangements’ (Williamson 1983), to scenarios such as equity-based hybrids (e.g. joint ventures) where parties cede ownership to a central hybrid entity. The arrangement of property rights limits the degree to which parties can gain leverage from dependence

⁵¹ Outside the structure of the hybrid governance itself, hybrids may also be governed by external monitoring by third parties. Ménard (2013) indicates that hybrid arrangements can be regulated by external authorities such as government agencies, regulators, arbitrating bodies or professional associations that monitor their activities, enforce contractual agreements, or mediate disputes. As these external authorities are outside the structure of the hybrid itself, they extend beyond the scope of this investigation.

relation, bonds parties to the collective endeavour, and also makes opportunism costly (Williamson 1983).

Hybrids may also centralise the decision rights to control or monitor partners. Hybrid parties may create central authority entities which are “institutional entities under which transactions are initiated, negotiated, monitored, adopted, enforced, and terminated” (Ménard 2013, p.1089). These “depend on the transfer by partners of subclasses of decisions to entities coordinating their action, while property and decision rights remain distinct” (Ménard 2006, p.35). Whilst still internal to the hybrid arrangement, they are typically a separate entity from the parties themselves, with dedicated central management staff (Grandori & Soda 1995). Although their capacities vary by the degree of decision rights ceded by hybrid parties, central entities can shape collective action, monitor parties activities, maintain control over pooled resources, determine the sharing of collective gains, discipline recalcitrant parties, enforce agreements, resolve internal disputes, and frame bargaining processes between internal as well as external parties. To perform these functions they may use additional planning, monitoring or incentive systems (Grandori & Soda 1995). However, they are considered ‘authorities’ rather than ‘hierarchies’ because they only exercise a limited set of rights, and rely upon consent (of the parties) rather than command to control (Ménard 2013).

Formalisation

Hybrids also safeguard against the risk of opportunism through formalised contractual agreements.⁵² There are there differences between hybrid contractual arrangements and those used to govern arm’s length market transactions. For example, parties typically provide longer-term contracts to match the length of the joint investments (Joskow 1988; Shelanski & Klein 1995; Williamson 1979, 1996). Also, whilst markets typically use exchange contracts that outline the terms of the goods and service exchange, hybrids will

⁵² Aside from incentive issues, contracts also are crucial in hybrids for coordination purposes, by specifying the selection criteria for partners and requirements of the transaction, shaping expectations of the duration of parties’ commitment (which are typically long-term), and providing for how the parties plan to adjust to various contingencies and (Ménard 2004).

typically augment these with associational contracts, which prescribe the organisation of the relationship (Grandori & Soda 1995).

Associational contracts may include clauses that specify the sharing rules for how gains from joint actions are to be distributed; restrictive provisions that limit the autonomy of parties; additional administrative and monitoring control mechanisms; specialised dispute resolution mechanisms, such as third party arbitration; and, conditions and penalties for non-compliant, underperforming or free-riding partners, including the ultimate threat of expulsion (Ménard 2004, 2013; Williamson 1996).

In terms of exchange contracts, hybrids tend to use ‘contracts as frameworks’. That is, compared to the complete spot contracts found in markets, hybrid parties rely on relatively incomplete contracts that give a broad indication of how relations may vary and provide guidance and indications of resolution processes should relations cease to work (Williamson 1991).⁵³ They use this style of contracting because of the significance of ‘non-contractibles’ (e.g. changing market conditions, uncertainties about the outcome of joint activities, measurement issues, and difficulty in defining property rights), all of which makes complete contracting prohibitively costly and difficult to enforce (Ménard 2013). However, contract incompleteness creates a greater need for other forms of control within hybrids. As Ménard (2004, p. 363) notes, “if contracts provide only a framework, complementary mechanisms are needed for monitoring and managing hybrids”.

Relational governance

As the identities of hybrid parties matter, exchanges within hybrids have much stronger relational emphasis than in more arms’ length contracting situations (Gibbons 2010; Gulati & Singh 1998; Klein, Crawford & Alchian 1978; Ménard 2013; Rindfleisch & Heide 1997; Shelanski & Klein 1995; Williamson 1979). The selection of parties is a significant issue, with partners referring to prior ties, partner experience and reputation as a means to assess ex ante the reliability of potential as part of their selection processes (Ménard 2013). The

⁵³ Contract as frameworks are supported by neo-classical contract law, which relieves parties from strict enforcement through ‘excuse doctrine’: some flexibility is given to unanticipated contingencies, and a level of tolerance of exceptions is given – disputes are generally resolved either privately or through third party arbitrators rather than court enforcement (Williamson 1991, 1996).

number of potential parties is another consideration, where partners may screen applicants and restrict the ‘specificity of access’ to the arrangement⁵⁴ (Grandori & Soda 1995), yet may also encourage the number of applicants to facilitate some form of competitive bidding discipline (Ménard 2004). Parties also invest in the development of close and enduring organisational ties, relational norms, and repeated exchanges (Rindfleisch & Heide 1997). This is because “deep and stable relationships based on group norms, reputation and peer control” (Grandori & Soda 1995, p.194) can form the basis of social or clan control (Ouchi 1980). Also close ties can provide information about cooperative behaviour of partners, which may inform choices of who to trust⁵⁵ or not (Geyskens, Steenkamp & Kumar 2006; Williamson 1996). Third, relational based contracts are thought to attenuate opportunism and regulate self-interest by creating ‘transactional reciprocity’ (Klein, Crawford & Alchian 1978; Ménard 2004), acting as a self-enforcing safeguard because the value of future business is sufficiently large that “neither partner wishes to renege” (Geyskens, Steenkamp & Kumar 2006, p.522). Finally, in the presence of incomplete contracts, relational contracting “can fill blanks left in contracts, monitor partners, and solve conflicts without repeated renegotiation” (Ménard 2006, p.30).

3.3.4. Describing variation in hybrid form

When Williamson eventually recognised hybrids as a valid governance mode⁵⁶, he viewed them as an intermediate form sitting between the polar modes of markets⁵⁷ and hierarchies⁵⁸; evident in the ‘semi language’ he used to describe the hybrid mode:

⁵⁴ Research shows that the openness of access generally reduces the broader the scope of cooperation (Grandori & Soda 1995; Ménard 2013).

⁵⁵ Trust can be conceptualised in three ways: contractual, competence, or goodwill trust, which respectively, refer to the confidence that the other party will fulfil their contractual obligations, has the requisite ability, and, given opportunity, will act in ways that are mutually, not just unilaterally beneficial (Sako 1992). Research shows trust to be an outcome from prior history, expectations of continuity or the interdependence of the two (Poppo & Zenger 2002).

⁵⁶ While early pioneering work on arrangements on franchising, long-term contracts, relational contracting, subcontracting and other forms of non-standard contracting emerged in 1970s and 1980s, it wasn’t until his 1985 book that Williamson acknowledged these organisational forms as relevant to TCE, stating that “...whereas I was earlier of the view that transactions of the middle kind were very difficult to organize and hence were unstable, ... I am now persuaded that transactions in the middle range are much more common” (Williamson 1985, p.83). This change of view was firmly reiterated in his 1991 paper, published in *Administrative Science Quarterly*, in which he again acknowledged TCE’s ‘neglect’ of hybrid forms, conceding that “the abstract attributes that characterize alternative modes of governance have remained

[the hybrid mode], *characterized by semi-strong incentives, an intermediate degree of administrative apparatus, displays semi-strong adaptations of both kinds, and works out of a semi-legalistic contract law regime. As compared with market and hierarchy, which are polar opposites, the hybrid mode is located between the two of these in all five attribute respects.* (Williamson 1991, p.281)

Although Williamson's (1991) paper gave recognition to hybrids as a category of governance within TCE theory, viewing them simply as different blends of market and hierarchical components may be insufficient to describe the variation of hybrid types forms found in reality (Ménard 2006). There is a diverse range of organisational arrangements that make up the hybrid category, such as joint ventures, subcontracting, strategic alliances, franchising, supplier parks and co-location, partnerships, consortia, cartels, trade associations, licensing agreements, supply chain systems, cooperatives, networks, reciprocal trading and long-term contracts (Barney & Hesterly 2006; Grandori & Soda 1995; Macher & Richman 2008; Ménard 2004, 2006, 2013; Ménard & Shirley 2005; Powell 1990; Shelanski & Klein 1995; Williamson 1991). The breadth and variety of organisational forms has led to depictions of the hybrid category as 'a collection of weirdos' (Ménard 2004, p.347) or 'the zoo' (Ménard 2013, p.1070). More extremely, some doubt the possibility of organising this variation systematically, arguing the relative merits of different hybrids and that the rules that influence their form "must be assessed on a case-by-case basis" (Masten 1996, p.12).

obscure" (Williamson 1991, p.270-1), and that "the hybrid form of organization is not a loose amalgam of market and hierarchy but possesses its own disciplined rationale" (p.294).

⁵⁷ Quoting Ben-Porath, Williamson (1979, p. 247) describes the market as "the classic nonspecific governance structure within which 'faceless buyers and sellers...meet...for an instant to exchange standardized goods at equilibrium prices". It is characterised by specializing "in the exchange of property rights through mechanisms that require the mutual consent of parties involved...and that coordinate the decentralised decisions made by agents using the information provided through the price system" (Ménard & Shirley 2005, p.303). Thus, in markets, contracting parties remain autonomous and their assets, property rights and decision rights remain distinct.

⁵⁸ 'Hierarchy' denotes when economic activities are organised internally within a firm, uniting contracting parties under common ownership. In this organisational form, parties no longer are autonomous, nor do they retain separate ownership of operations. Instead, contracting parties surrender significant decision rights to an internal 'third party', 'interface coordinator', or 'central coordinator' within the hierarchy (i.e. 'the boss'), who mediates the exchange and exerts control over the operations of both parties (Ménard & Shirley 2005; Tadelis & Williamson 2013).

There have been several attempts by scholars to develop more meaningful ways to capture the variation in hybrid types (Grandori 1997; Ménard 2004, 2006, 2013; Powell 1990). Three of these attempts categorise different hybrid types based on the same structural dimensions I introduced in Section 3.3.3.

The first was an early conceptual piece by Grandori and Soda (1995), who classified various forms of inter-firm networks on the basis of three dimensions: the degree of centralisation – whether there is a central coordinating firm or more parity, symmetrical relations amongst parties; the degree of formalisation – whether the arrangements are supported by formal associational contracts; and the mix of coordination mechanisms. Using these dimensions the authors classified and differentiated various forms of: social networks⁵⁹, which generally have low formalisation, low to high centralisation, and high reliance on relation mechanisms; bureaucratic networks⁶⁰, which had high formalisation, low to high centralisation, and relied on various forms of social and procedural mechanisms; and proprietary networks⁶¹, which have both high formalisation and high centralisation (i.e. equity commitments), and used social, bureaucratic and incentive coordinating mechanisms.

The second was a comprehensive review by Claude Ménard⁶² in 2004 (Ménard 2004). He argued that there was an “underlying pattern beyond the heterogeneity of cases” (p.350) and that “the diversity of hybrids and the decision by partners to adopt a specific form among this diversity are not random decisions” (p.368). Based on actual hybrid practices observed by prior empirical work, Ménard categorised hybrids in terms of the degree of centralisation and formalisation of governing entities, ranging from highly decentralised arrangements, which rely on ‘trust’ based management and expectations of reciprocity; relational networks, with mild authority, based on long-standing relationships and

⁵⁹ This category included personal networks, interlocking directorates, industrial districts, outsourcing, sub-contracting and network constellations.

⁶⁰ This category included inter-firm associations (trade associations, cartels and federations), consortiums, agencies, licensing arrangements, franchises, and sub-contracting.

⁶¹ This category included joint ventures and capital ventures.

⁶² Claude Ménard has written extensively about the nature and categorisation of hybrid organisations (Ménard 1996, 2004, 2006, 2013; Ménard & Shirley 2005).

development of social conventions; hybrids coordinated by a leader (e.g. subcontracting); and hybrids governed by formal governing bodies.

Finally, in 2013 Ménard presented a modified typology (Ménard 2013) focusing primarily on centralisation. He decomposed centralisation into two dimensions: centralisation of property and decision rights (i.e. the density of pooling of strategic resources and the rights over those resources), and the degree of centralisation in monitoring, controlling or coordinating partners. Sitting across this spectrum⁶³, he proposed that the hybrid category could also be classified into three different types, depending on their dominant governance mechanism: those which relied on information platforms (e.g. information exchanges between geographic hubs of firms; consumer associations); those which relied on third party monitoring and arbitration (e.g. strategic alliance; cooperatives supported by public funding), and those which relied on central authority entities (e.g. joint ventures). Collectively, these contributions from prior economic literature indicate that the structural dimensions describing how hybrids enact governance are also useful in describing the variation between different types of hybrids. They show it is possible to develop more systematic approaches to studying various hybrid forms if they are classified by the degree of centralisation, and perhaps formalisation. Furthermore, these studies indicate that different hybrids are characterised by the combination of hybrid-specific ‘mechanisms of governance’. Interestingly, they concede that the theoretical development about the design and operation of these mechanisms remain partial and provisory (Grandori & Soda 1995; Ménard 2004, 2006, 2013), which indicates the potential value of inter-organisational control research in terms of understanding the types of embedded mechanisms, systems and practices (i.e. MCS) that underpin different types of hybrid arrangements.

3.3.5. Hybrid structures in inter-organisational R&D

Although researchers have not studied hybrid structures in relation to cooperation problems in inter-organisational R&D per se, several prior studies about inter-organisational R&D arrangements or ‘R&D alliances’ provide a sense of the variation in types of hybrid

⁶³ Ménard (2013) envisioned all organisational forms on or around an efficient frontier, from low centralisation of property rights and high decentralisation, to high centralisation of property rights and low decentralisation.

structures likely to be found in practice (e.g. Dekker 2004; Gietzmann 1996; Gietzmann & Larsen 1998; Gulati & Singh 1998; Miller, Moll & O'Leary 2012; Miller & O'Leary 2005a; Miller & O'Leary 2005b; Miller & O'Leary 2007; Mouritsen, Hansen & Hansen 2001; Oxley 1997; Pisano 1989; Revellino & Mouritsen 2009; Sampson 2004). The types of hybrids examined by these studies align neatly with the categorisation of hybrids described in the previous section. Similar to Williamson (1991), several authors view collaborative R&D arrangements as existing across a spectrum ranging from more market-like to hierarchical alliance forms; in addition, they differentiate these types by the degree of centralisation of property rights, ranging from more market-like purely contractual arrangements to more hierarchical equity-based inter-organisational R&D arrangements (Gulati & Singh 1998; Oxley 1997; Pisano 1989; Sampson 2004).

Contractual R&D arrangements

Contractual R&D arrangements occur when parties contract directly with one another for the purpose of collaborative R&D (Gulati & Singh 1998; Oxley 1997; Sampson 2004). These arrangements are characterised by low levels of centralisation; they do not involve the sharing or exchanging of equity and typically do not involve the creation of a separate entity (Gulati & Singh 1998). Furthermore, parties retain autonomy over their own operations while decision-making is decentralised (Sampson 2004). Because of the lack of centralised ownership and monitoring structures, contractual arrangements have relatively low reliance on hierarchical controls:

[There are]...few if any command structures, authority systems, incentive systems, standard operating procedures, dispute resolution procedures, or non-market pricing systems are necessarily part of such arrangements...while some hierarchical elements...may occur in some contractual alliances, they are not necessarily widespread and do not occur on a systematic basis. (Gulati & Singh 1998, p.793)

Instead, as their name implies, contractual R&D arrangements rely on the safeguards within the formalised contractual arrangements, which may be long-term or have particular clauses relating to reporting requirements, operating procedures or dispute resolution (Gulati & Singh 1998). Even so, as the types of hybrid closest to market governance, contractual arrangements retain some of the governance characteristics of markets (Sampson 2004),

such as a reliance on the price mechanism⁶⁴, incentive intensity⁶⁵, supplier competition⁶⁶ and legally enforceable contracts⁶⁷.

In terms of types of contractual arrangements, authors such as Oxley (1997) differentiate between unilateral and bilateral contractual R&D agreements. Unilateral contractual arrangements “primarily involve one-way transfer of technology in return for cash payments” (Sampson 2004, p.488) and include unilateral licensing, long-term supply contracts, and R&D contracts. For example, the case studies by Mouritsen, Hansen and Hansen (2001) and Revellino and Mouritsen (2009) both centre on focal firms who subcontract new product design and development to various technology suppliers within large, decentralised networks. In both cases, the focal firm sought to speed the pace of development by contracting with multiple suppliers simultaneously and using short-term contracts that enabled them to switch between different technological opportunities as they emerged. Mouritsen, Hansen and Hansen (2001, p. 231) describe the relations with suppliers under this form of subcontracting:

⁶⁴ The price mechanism is central the market governance structure and its capacity for ‘autonomous adaptation’ (Hayek 1945). Market participants respond to disturbances in the external environment via changes in relative prices; economic actors then adjust independently and seemingly spontaneously, without the need for any further coordination or intervention.

⁶⁵ Market exchanges across a highly discrete interface (i.e. the activities of both parties are highly separable), also provide a high level of incentive intensity. Incentive intensity refers to the degree that changes in effort expended affects parties (performance) compensation (Williamson 1991). Tadelis and Williamson (2013, p. 166) explain that this depends on “the extent to which a technologically separable stage of economic activity is able to appropriate its own net profit”. This in turn depends on how separable the activities of the parties are, and the way parties are compensated for their efforts (i.e. market prices provide higher incentives over cost-plus pricing). The inherent incentive intensity of governance structures affect whether contracting parties will act independently and autonomously to maximise their own efficiency and keep costs low. As Williamson (1996, p. 103) describes: “other autonomous traders have neither legitimate claims against gains nor can they be held accountable for the losses”. Thus market prices “provide powerful incentives for the exploitation of profit opportunities and market participants are quick to adapt to changing circumstances as information is revealed through prices” (Shelanski & Klein 1995, p.337).

⁶⁶ Market prices, and the simple spot contracts in which they are embedded, also form the basis of discipline and dispute resolution. Because all relevant information is distilled within the market price, the identities of trading parties is irrelevant, creating large numbers competition with other suitable alternatives available (Geyskens, Steenkamp & Kumar 2006).

⁶⁷ The simplicity of spot contracts enables the use of classical contract law or ‘black letter law’, where disputes can be settled efficiently through litigation and external court enforcement (Williamson 1979, 1985, 1991, 1996). Of course, this presumes the existence of a strong legal institutional environment in which property rights are protected (Ménard & Shirley 2005; Williamson 1979, 1985, 1991, 1996).

The firm required flexible supplier relations to allow them to ‘swap’ one supplier for another and to exploit different technological potentials embedded in the whole network of suppliers. The co-operation between NewTech [the focal firm] and its suppliers turned strategic and was handled by the remaining development engineers who conducted coordinating activities more than detailed development work. A more fragmented technological base replaced the previous technological core.

Similarly Revellino and Mouritsen (2009) described the intention of their focal case firm to stimulate supplier competition to provide alternative technological solutions. As one of their informants described:

In that mega-project every company had the aim of ousting another: Digital had the aim of ousting IBM . . . , IBM wanted to throw Digital out . . . Olivetti was chafing at the bit to find a role for itself in wider spaces; Marconi had the ambition to do something that it never succeeded in doing, that is to create that evolution of Telepass represented by the multilane solution. Our idea was to take advantage on those conflicts, stimulate the interest of those companies to combine the best resources. (Revellino & Mouritsen 2009, p.351)

This view, that under unilateral R&D contracting suppliers will compete, is also inherent in the papers by Gietzmann (Gietzmann 1996; Gietzmann & Larsen 1998). The assumption that buyers retain the ability to switch between alternative suppliers forms the basis of the problem of motivating specialised supplier investments as well as solutions, such as rank order tournaments and promotion ladders.

In comparison, bilateral or ‘pooling’ contractual agreements include technology sharing, cross-licensing, and joint research agreements (Oxley 1997). Like in unilateral contracting, decision-making remains highly decentralised, as each party makes its own decisions about how to fulfil its contractual obligations; however, there is more pooling of resources and sharing of joint outcomes (Sampson 2004). This creates more opportunities to align party interests, as the bilateral exchange enables the parties to enact an in-kind hostage exchange because “both parties have a continued interest in the maintenance of the arrangement, and ex post haggling will be reduced as a consequence” (Oxley 1997, p.393).

An example of these sorts of contractual agreements can be found in Miller and O'Leary's study of technological development in the US semiconductor industry (Miller, Moll & O'Leary 2012; Miller & O'Leary 2005a; Miller & O'Leary 2005b; Miller & O'Leary 2007). Members of a broad joint research agreement, including competing chipmakers, typically did not share or exchange equity and retained their own autonomy in making decisions about their own investments in technology development. However, they used various formalisation mechanisms to synchronise their investments in different technological options, with the shared understanding that only one such option would be adopted industry-wide.

Equity-based R&D alliances

Equity based R&D alliances are arrangements where the partners share or exchange equity (Gulati & Singh 1998; Pisano 1989). This creates a centralised ownership structure that aligns party interests, reduces incentives, and safeguards investments, and provides a centralised governance structure, such as a board of directors, that monitors and controls the collective activities, resolves disputes and makes decisions when unexpected contingencies arise (Pisano 1989). Similar to traditional hierarchies, the reliance on centralised command and control systems compensates for the loss of incentive intensity that occurs when activities are structured within a shared ownership structure rather than market-based arrangements (Oxley 1997). Typically equity based alliances also rely on a high degree of formalisation, as parties use enforceable contracts ex ante to agree on the contributions they will commit to the arrangement, as well as ways in which the revenue streams and assets will be distributed during its term and at its termination (Gulati & Singh 1998). Furthermore, because parent firms do not have the same singular authority as traditional hierarchies, they must often negotiate and compromise if conflicts arise. Therefore, contracts often contain explicit clauses regarding the right of veto over strategic decisions (Oxley 1997).

The prototypical form of an equity-based alliance is an equity joint venture, where two or more parties pool resources together to create a separate, jointly owned entity (Gulati & Singh 1998; Oxley 1997; Pisano 1989). Pisano (1989) differentiates between operating and non-operating joint ventures, where operating joint ventures perform activities on behalf of

its parents in its own facilities, and non-operating joint ventures act only in an administrative and legal capacity (and the parent organisations perform the operational activities).⁶⁸ In both cases, the pooling of equity by the parent organisations creates a repository of contributions that becomes the legal property of the alliance, rather than the property of the parents, until dissolution (Sampson 2004). Thus, equity contributions operate as a ‘hostage exchange’ “because the value of joint venture depends critically on continued operation, each firm effectively posts a bond equal to its equity share, the value of which is at best only partially redeemable should operations cease” (Oxley 1997, p.390).

Furthermore, the centralised separate entity typically has its own independent administrative command and control structure, with clearly defined rules and responsibilities, standard operating systems and dispute resolution mechanisms (Gulati & Singh 1998). Equity joint ventures typically are administered by a joint board of directors “which allows for greater partner communication and control and often requires firms to come to a consensus on strategic-level decisions” and autonomous day-to-day management, independent from the parents, which “allows greater ‘self-determination’ by the joint venture...such that resources contributed to the alliance are more likely to be used in a fashion that is consistent with alliance goals (i.e. joint) rather than parent objectives (i.e. individual)” (Sampson 2004, p. 489).

As an example, the study by Dekker (2004) describes the use of an equity joint venture to structure the development and delivery of technology for railway safety equipment between two firms. The parent organisations pooled financial resources as well as technical knowledge and personnel to the joint arrangement. This involved the creation of a separate entity that was staffed by its own employees and monitored and controlled by a board of directors made up of representatives of the two parent organisations. The arrangement was shaped by the use of a five year associational agreement that specified the organisation structure; the planned goals, objectives and activities of the alliance; the partners’ responsibilities; the property rights related to intellectual property; the nature of the mechanism used to determine the allocation of value (cost-reductions from improved

⁶⁸ Pisano (1989) notes that in practice any given joint venture may represent a combination of non-operating and operating elements.

designs) between the parents; as well as an investment fund for the entity. There was a high degree of reporting of performance outcomes compared to planned benchmarks which were monitored by the management of both parent organisations.

An alternative type of equity-based alliance is what researchers have labelled ‘minority equity investments’ (Gulati & Singh 1998) or ‘direct equity participation’ (Pisano 1989). This occurs when one firm purchases a minority share⁶⁹ of a partner’s equity, and thereby becomes a partial owner; however, as this is a direct investment by one firm in another, there is no creation of a separate entity. Because of the shared ownership structure⁷⁰, which is formalised in terms of an enforceable shareholder agreement, minority equity investments create an alignment of interests, as both parties have mutual stakes in ensuring the collaboration is successful, as well as protecting party investments by providing an enforceable mechanism to distribute assets in the case of termination (Gulati & Singh 1998). Also, the investing firm commonly has representatives on the partner organisation’s board of directors, enabling them the opportunity to monitor and control the collaboration, as well as resolve conflicts, and to participate in decision-making as contingencies arise (Pisano 1989). However, as no separate entity has been created, there are typically less hierarchical controls developed and used in minority investments compared to joint ventures, and operations of the parties are still administered by their own personnel and administrative systems (Gulati & Singh 1998; Oxley 1997).

3.3.6. Summary

In summary, while the features of hybrid governance have received inconsistent coverage by management accounting research, economic literature provides several insights into the nature, control capacity and variation of hybrid governance structures. Hybrid governance is revealed to be a highly diverse category of organisational forms, encompassing a wide variety of arrangements in which autonomous partners pool resources, and where governance is enacted through a combination of centralisation, formalisation and relational governance. These structural characteristics also form the basis of dimensions used to

⁶⁹ Less than 50% share.

⁷⁰ “A direct equity investment by one firm into another essentially creates an equity joint venture between one firm’s existing shareholders and the new corporate investor” (Pisano 1989 p.111).

describe systematic various types of hybrids. For example, prior research has contrasted different types of inter-organisational R&D arrangements in terms of the degree of centralisation of property rights, ranging from more market-like arrangements, such as contractual R&D arrangements that have low centralisation, to more hierarchical forms, such as highly centralised equity-based R&D alliances.

3.4. Management control systems within hybrid arrangements

The aim of this section is to understand the types of control solutions comprised by the MCS found within hybrid R&D arrangements. As described in Section 3.2.2 and Appendix A, researchers have used a diverse range of approaches and frameworks to conceptualise MCS responses to cooperation problems in inter-firm settings, from the detailed design of contractual agreements (e.g. Anderson & Dekker 2005; Birnberg 1998; Dekker 2008), to broad archetypes or patterns of control (e.g. Speklé 2001; Van der Meer-Kooistra & Vosselman 2000). In this thesis, I use a conceptual approach that lies between these two extremes. Similar to several previous studies (e.g. Dekker 2004; Gulati & Singh 1998; Johansson & Siverbo 2011; Neumann 2010) I categorise potential MCS control solutions in terms of general types of ‘organisational mechanisms of governance’. These include: planning, monitoring and reporting systems, incentives, and social-based mechanisms.

There are two reasons why I have chosen this relatively simple categorisation of the embedded MCS within hybrids. First, there is no readily available framework that provides sufficient guidance about the MCS likely to be found within different hybrid arrangements. This is because very few existing inter-organisational control frameworks describe variation in both hybrid structure and MCS; those that do include reference to MCS only cover a very limited subset of hybrid types; and, it is often not clear how the relation between MCS and hybrid structure control solutions is conceptualised. Therefore, adopting a relatively simple categorisation of the *types* of MCS found in hybrids provides analytical parsimony and flexibility⁷¹, which allows me to focus on the different *relations* between MCS and other conceptual elements of the study.⁷²

⁷¹ For example, while existing studies have classified MCS into ex ante and ex post controls, it is not clear how these relate to ex ante and ex post control problems. By classifying MCS by type I can explore what

Second, with the exception of a handful of studies (e.g. Dekker 2004; Gietzmann 1996; Gulati & Singh 1998), TCE theory has not been applied to explain the use of MCS in inter-organisational R&D settings. TCE-based accounting research has generally been based in non-R&D settings; and inter-organisational R&D studies have explained MCS in relation to other control problems (e.g. appropriation and coordination). Categorising MCS by the type of control mechanism will enable an easier integration of both literatures, as I will be able to examine the overlap between the mechanisms observed in inter-organisational R&D arrangements and the types of cooperation control solutions proposed by inter-organisational control research.

In the four sub-sections below I will explore the nature of planning, monitoring and reporting systems, incentives, and social-based mechanisms found previously in inter-organisational R&D arrangements, and, with reference to broader inter-organisational control research, explain how they might be used to address cooperation problems.

3.4.1. Planning mechanisms

The first category of MCS found previously within inter-organisational R&D arrangements is the use of planning mechanisms, which involves “pre-setting schedules, outcomes and targets; and rules, programs and procedures” (Gulati & Singh 1998, p.786). The types of mechanism observed by prior studies vary in their scope, time frame and detail; ranging from long-term visions and strategic plans to shorter-term operational planning practices.

Revellino and Mouritsen (2009) and Miller and O’Leary (2007) both observe the use of vision statements to motivate interest and direct behaviour within networks of technology suppliers. Although these visions are highly abstract and loosely formulated, they capture and express the central premise of the technology. In Revellino and Mouritsen (2009, p. 348) this was “the idea that mobility could be simple, stress-free and fast; and thus it would not appear to be expensive to the motorist”; whereas Miller and O’Leary (2007) detail the

mechanisms are used to address different control problems at different stages, leaving open the possibility that the same mechanism, e.g. a strategic plan, may be used to control all three different problems at different stages of a project contract.

⁷² For example, the relations between the different components of the control solutions (i.e. between hybrid type, hybrid structures and MCS); and, between the control solutions and each of the three control problems.

role of ‘Moore’s law’ – an expectation that the number of electronic elements on a semiconductor could continue to be doubled approximately every two years, without any increase in cost per device – as shaping the collective expectations of firms in the US semiconductor industry about the required pace of development.⁷³ While vision statements lack the detail of other planning devices, they direct and guide behaviour by developing shared expectations and goals, garnering interest and motivating competition. As Revellino and Mouritsen (2009, p. 348) observe, “this vision was a control in the sense that it influenced and directed innovation ambitions and proposed a possible future situation to which developers and designers could manoeuvre their activities”.

These two studies also observe the use of strategic planning to supplement vision statements. For example, in Revellino and Mouritsen (2009) the company used strategic mapping devices to integrate the contributions of different technology suppliers. Miller and O’Leary (Miller, Moll & O’Leary 2012; Miller & O’Leary 2005a; Miller & O’Leary 2005b; Miller & O’Leary 2007) document how Moore’s Law is translated into the use of ‘technology roadmap’ which “...sets out the shared expectations of the various groups that invest to design components, as to when these will be available, and how they will inter-operate technically and economically, to achieve system-wide innovation” (Miller & O’Leary 2005a, p.163).

These collective strategic plans specified industry-wide goals relating to technology development and cost reductions; they structured and sequenced individual organisations’ innovation programs into industry-level objectives; and they identified points in time when the next generation of process technology was to be made available.⁷⁴ The roadmap also provides incentives to suppliers and research agencies by communicating the potential

⁷³ ‘Moore’s Law’ is derived from predictions made by Intel’s co-founder and chairman Gordon Moore in 1965, when he predicted a thousand-fold increase in the power of semiconductor devices in the next decade. In 1975 his expectations proved accurate and soon, the expected rate of technological development – a doubling of the number of transistors per integrated circuit– soon was adopted as an industry norm, becoming so widely held, that it is embedded with investments and planning of all related industries (Miller & O’Leary 2007).

⁷⁴ These technology nodes tend to be sequenced every 2–3 years.

returns of developing new technologies and creating confidence that there will be a 'market' for their technology (Miller & O'Leary 2005a; Miller & O'Leary 2007).⁷⁵

At a more operational level, Mouritsen, Hansen and Hansen (2001) observe the development of functional analysis⁷⁶ by a firm to communicate its expectations regarding new components developed by external suppliers. The firm specified expected performance criteria in terms of the components' required functionalities, which also became the basis for evaluating and monitoring technology supplier outputs.

Finally, Dekker (2004) describes the use of several interlinked planning devices, relating to the design and development of joint innovation, that reduces total cost of ownership and improves quality and safety. These include the broader strategic goals and objectives; shorter-term goals concerning cost reduction and order quantity; the development of quality plans and procedures; and an operational planning system for developing and coordinating individual innovation proposals. Within this operational planning system ('program of improvement'), each new proposal is accompanied by a planning and progress scheme (outlining the sequence of project activities, and the expected functional requirements), a budget scheme, and an expected cost reduction.

Although planning mechanisms have tended to be described in terms of their coordinative capacity, they may also address cooperation control problems. Planning devices may act as ex ante control mechanisms that "mitigate control problems by aligning partners' interests...before implementing the IOR [inter-organisational relationship]" (Dekker 2004, p.32). They can be used to set collective targets and assign responsibilities to each partner, which, as Gulati and Singh (1998, p. 786) explain, "limits negotiation on each issue and pre-empts conflicts between interdependent units in the future". Also, planning devices enable parties to discuss, negotiate and resolve technical problems and develop clearer

⁷⁵ This is because although multiple process technology options are often developed in parallel, typically this is done with the expectation that only one process would eventually be adopted by all semiconductor producers. This means "the successful technology could thus enjoy industry-wide demand for several coordination nodes" (Miller & O'Leary 2005a, p.168).

⁷⁶ Functional analysis, an element from target costing, specifies the expected criteria/outcomes in terms of the products' required functional qualities from a customer's point of view. These criteria become the basis for communicating the expected technology requirements to the supplier, and also the basis by which NewTech could monitor and evaluate the supplier.

expectations of tasks and outputs. This reduces uncertainty and enables the specification of targets and performance indicators that can serve the basis of future performance evaluation (Langfield-Smith 2008; Langfield-Smith & Smith 2003; Mouritsen, Hansen & Hansen 2001). Planning may also reduce the occurrence of opportunism by enabling greater information exchange and sharing, and familiarity, which leads to more open and trusting relations between parties (Langfield-Smith & Smith 2003).

3.4.2. Monitoring and reporting systems

Inter-organisational R&D arrangements may also rely on a variety of monitoring and reporting systems. These are characterised by the assignment of managerial control authority to a partner or central body, who monitor activities and outputs to ensure they are compliant with the agreed procedures and performance targets.

In Revellino and Mouritsen (2009) the monitoring was conducted by the focal buyer firm who introduced a framework of indicators (focused around quality of outcomes arising from the technology) and ‘quality reports’. These were used to benchmark the innovation, to satisfy the interests of stakeholders, and to convince users of the viability of the innovation.

In the study by Miller and O’Leary (Miller & O’Leary 2005a; Miller & O’Leary 2007) the monitoring function was performed by a central consortium made up of delegates from semiconductor producers and related organisations (e.g. their suppliers, customers and related vendors). The central body would meet regularly to conduct intensive industry-wide assessments of the state of development component R&D. These assessments would then be used to revisit the feasibility of projections and update the expected priority, timing and outcomes of different technology programs within the roadmap.

In the case by Dekker (2004), the monitoring and reporting was conducted by managerial bodies within a centralised entity created at the alliance’s inception. The most significant was the alliance board, comprised of representatives from the parent organisations, which conducted pre-action reviews of innovation proposals and quarterly and annual performance reviews of the progress of the alliance towards its goals. Operational

management was enacted by six staff task groups, including teams responsible for annual evaluations of cost reductions resulting from innovation and audits of quality control.

Monitoring and reporting mechanisms represent what inter-organisational management control researchers describe more broadly as ‘bureaucratic control’ (Caglio & Ditillo 2008; Johansson & Siverbo 2011; Phua, Abernethy & Lillis 2011; Van der Meer-Kooistra & Vosselman 2000) or ‘machine control’ (Speklé 2001). These rely on “the existence of specified norms, standards and rules...[and] systems of surveillance, evaluation, and direction” (Van der Meer-Kooistra & Vosselman 2000, p.59). The intent of these types of controls is to provide frequent supervision and regular performance evaluation of the quantity and/or quality of output or activities (Van der Meer-Kooistra & Vosselman 2000).

Monitoring and reporting systems address cooperation control problems because they:

...reduce information asymmetry and make shirking or failure to provide information either more difficult or less favorable...[and] they assume an important signalling function, since they serve to indicate that opportunistic behavior will not only be detected, it could also have negative effects on a company's reputation.” (Neumann 2010, p.223)

That is, they mitigate and manage opportunism by ensuring compliance to predefined norms and standards, reducing incentives to engage in opportunistic games, monitoring each party's contribution and performance, and adjudicating disputes (Gulati & Singh 1998; Phua, Abernethy & Lillis 2011; Speklé 2001).

3.4.3. Incentives

The third type of mechanism found within inter-organisational R&D arrangements is incentive systems. These mechanisms are typically contingent on the measurable outputs captured by monitoring and performance reporting, but appear to vary in the nature of rewards offered.

More typical incentives are financially-based, involving some form of profit-sharing. For example, Dekker (2004) describes how equity alliance partners make equal financial contributions towards innovation at the start; as the innovations accrue financial results (in the form of cost savings resulting from improved product designs), some is reinvested in

the alliance fund for future innovations and the remaining residual divided between the partners. Dekker explains that this system induces mutual collaborative behaviour by aligning partners' individual (financial) objectives with the alliance's overall objectives. This corresponds with broader inter-organisational control research which explains how incentives mitigate opportunism by aligning partner interests (Gulati & Singh 1998; Van der Meer-Kooistra & Vosselman 2000) and making recalcitrant behaviour costly (Speklé 2001). As Neumann (2010, p. 223) explains, the general rationale is that both partners will be motivated to perform well if their profits depend directly on their joint efforts.⁷⁷

The studies by Gietzmann (Gietzmann 1996; Gietzmann & Larsen 1998) discuss the use of an alternative type of rewards – promotion ladders – where suppliers are offered opportunities for more favourable future contracts (preferred status, and more profitable design assignments), on the basis of relative performance appraisals and rank order tournaments. These sorts of rewards are argued to motivate suppliers to make dedicated investments in relation-specific skills, so long as the rewards of specialisation are sufficiently high and suppliers have a reasonable expectation that they might be able to access them in the future.⁷⁸

3.4.4. Social-based mechanisms

Finally, parties within inter-organisational R&D arrangements may rely on social-based mechanisms to address cooperation control problems. Within the inter-organisational management control literature several authors have described social-based mechanisms in reference to a notion of trust, which at a very general level describes a willingness to be vulnerable to another party, based on positive expectations about the likelihood a trusted

⁷⁷ However the effectiveness of these rewards is also dependent on how easily it is to assign outcomes to one particular partner; when this becomes difficult “outcome based rewards can create an incentive to shirk, making the monitoring of behavior and the use of behavior-based rewards or sanctions more effective” (Neumann 2010, p.223).

⁷⁸ Gietzmann and Larsen (1998) details a number of assumptions regarding the expected design of such rewards, including the initial task – it needs to be sufficiently difficult to test the competence of the suppliers, it needs the suppliers to have to make relation-specific investments, and it needs to be able to reveal supplier ability. Also, the reward of future tasks needs to be sufficient to cover the expected private cost of specialisation incurred by suppliers if their subsequent contracts are not renewed. Finally, they propose that such a scheme is likely to be most effective when both suppliers and buyers are unsure about the suppliers' ability ex ante (such as technology settings). This is because if the supplier already knows they are unlikely to meet ability thresholds they will not be motivated in the first place.

partner behaves in a desirable way⁷⁹ (Dekker 2004; Donada & Nogatchewsky 2006; Johansson & Siverbo 2011; Langfield-Smith 2008; Langfield-Smith & Smith 2003; Phua, Abernethy & Lillis 2011; Van der Meer-Kooistra & Vosselman 2000). Trust⁸⁰ may be influenced by a range of managerial practices, such as partner selection procedures and trust-building mechanisms (Dekker 2004; Phua, Abernethy & Lillis 2011).

In the context of inter-organisational R&D, previous studies highlight how organisations are selective in terms of which suppliers they contract for technology development. For example, Mouritsen, Hansen and Hansen (2001) describe a focal firm's segmentation of suppliers, differentiating between suppliers used for production and development of standard units who were used as a 'library' that they could easily switch between, and a smaller subset of suppliers who were directly involved in development of customised, specialised technology. Likewise, Gietzmann (1996) described Japanese auto-assemblers strategic use of suppliers, segmented into three categories: suppliers with whom they have one-off transactions; marginal suppliers, used as capacity buffers for production tasks; and finally, a selection of suppliers of design work, with whom the assembler sought to build long-term relations subject to repeated appraisal. These segmentation strategies address opportunism by creating promotion incentives for suppliers to behave cooperatively (Gietzmann & Larsen 1998). In addition, being selective about the choice of partner is argued to mitigate control problems and goal incongruence; by assessing a potential partner's norms, values and motivations, firms can intentionally choose organisations that display indicators of cooperative behaviour and with whom they share a 'cultural fit' (Dekker 2004). For example, Dekker (2008, p. 921) argues that "provided that buyers have a choice among potential partners, investing more effort in evaluating and comparing

⁷⁹ Drawing on the work by Sako (1992), management control researchers tend to differentiate between different forms of trust, including *contractual trust*, where parties assume the other will honour their agreement; *goodwill trust*, where parties expect the other to behave in the interests of their relationship; and *competence or capability trust*, where parties expect the other to have the requisite abilities to perform tasks satisfactorily (Dekker 2004; Donada & Nogatchewsky 2006; Emsley & Kidon 2007; Langfield-Smith 2008; Langfield-Smith & Smith 2003).

⁸⁰ As Langfield-Smith and Smith (2003, p. 284) note, "trust is a difficult concept to study as it has been defined and classified in many ways". Some authors adopt alternative conceptions viewing trust itself is a control mechanism, or trust as characterising patterns of control (Vosselman & Meer-Kooistra 2009).

potential partners may increase confidence in the goodwill and capabilities of the chosen partner”.

Building on the work by Das and Teng (1998), Dekker (2004) also describes a range of trust-building mechanisms found within an innovation alliance. These include deliberate risk taking, high levels of interaction between partners, joint goal setting, problem solving and decision-making, open book agreements, intentionally incomplete contracts, and concern by managers for the maintenance of the parents organisations’ reputation as a trading counterpart. He demonstrates the high level of goodwill trust between partners and how situations are handled by the partners acting in ‘good faith’, referring to instances where there is a lack of opportunism even when incentives and performance monitoring are incomplete, and the incompleteness of intellectual property safeguards.

Similarly, Gietzmann (1996) summarises a range of practices used by Japanese auto assemblers to build trusting relations with long-term suppliers. For example, buyers seek to maintain their reputation as good trading counterpart, by exercising ‘dualistic control’ where they “consciously constrain their own behavior in order to engender trust and to signal a desire not to act opportunistically” (Gietzmann 1996, p.624). Buyers would invest time in visiting and providing advice to suppliers, encourage high information exchange and repeated interactions, and would refrain from hasty terminations of below performance suppliers. Gietzmann (1996, p. 623) concluded that governance modes based on “minimizing supplier bargaining power...is inconsistent with the strategy of wishing to develop collaborative ventures in product innovation”.

Building long-term trusting relations in inter-organisational arrangements is considered important as it acts as an informal self-enforcing safeguard, by reducing the likelihood that parties will behave opportunistically (Birnberg 1998; Dekker 2004; Langfield-Smith & Smith 2003).⁸¹ Trusting relationships are likely to be more durable, even in situations of conflict, as partners will seek to promote the other’s interests and “increase the

⁸¹ Numerous authors have proposed that reliance on trust-based mechanisms may substitute for other types of mechanisms (Gulati & Singh 1998; Powell 1990). This is supported by studies which have found, for instance, the level of repeated ties between partners is associated with diminished or less extensive use of other governance mechanisms or hierarchical control (Dekker 2008; Gulati & Singh 1998).

predictability of mutual behaviour through each party honouring commitments and allowing partners to deal with unforeseen contingencies in mutually acceptable way” (Langfield-Smith & Smith 2003, p.284). This is supported by studies that show, for example, that repeated ties between partners are associated with diminished use of other governance mechanisms or hierarchical controls designed to safeguard against opportunism and power asymmetries (Dekker 2008; Gulati & Singh 1998).

3.4.5. Summary

Previous studies of inter-organisational R&D arrangements have found a range of MCS in use. They include long-term visions and strategic plans; shorter-term operational planning practices; monitoring and performance reporting systems; financial incentives; promotion rewards; partner selection practices; and activities designed to build trust. Although these mechanisms have often been described by R&D studies in terms of their capacity to address coordination requirements or mitigate the risk of appropriation, they correspond to the types of control solutions described by the broader TCE-based inter-organisational management control research. Thus, it appears that these types of mechanisms represent useful categories to explore how MCS, embedded within hybrid arrangements, address cooperation control problems in inter-organisational R&D arrangements.

3.5. Chapter summary

In this chapter I have reviewed existing literature to inform the possible control solutions for addressing cooperation control problems in inter-organisational R&D exchanges. Based on the existing approaches in inter-organisational control research (summarised in Section 3.2), I have focused on two different types of control solution choices: the choice of hybrid governance structure and the choice of embedded MCS.

Upon closer examination of the choice of hybrid governance in Section 3.3, I find a general lack of consistency in the way accounting researchers have approached the control capacity and variety of hybrid governance structures as solutions to cooperation control problems. Thus, I integrate two key insights from broader economic literature: the structural dimensions (formalisation, centralisation and relational governance) that give hybrids their control capacity; and the variation in hybrid forms in practice, which ranges from market-like contractual arrangements to hierarchy-like equity-based alliances

Finally, in Section 3.4 I conceptualise the types of MCS control solutions likely to be found within hybrid R&D arrangements. Although there are many alternative ways researchers have approached this construct, I categorise embedded MCS control solutions in terms of general types of mechanisms in order to be able to examine the overlap between the mechanisms observed in inter-organisational R&D arrangements and the types of cooperation control solutions proposed by inter-organisational control research. This resulted in development of four types of embedded MCS control solutions, including: planning, monitoring and reporting systems, incentives, and social-based mechanisms.

Having conceptualised the nature of cooperation control problems in Chapter 2 and the nature of hybrid governance structure and embedded MCS control solutions in Chapter 3, in the following chapter I will explore the relations and inter-dependencies between these constructs.

Chapter 4: Interdependencies between control solutions and problems

4.1. Introduction

The aim of this chapter is to conceptualise the interdependencies between different control solution choices and to propose how they may address the cooperation problems in relation to inter-organisational R&D exchanges. In Section 4.2 I consider the nature of the relation between MCS and hybrid structure control solutions by analysing the different ways this relation has been accounted for by previous studies. Then, in Section 4.3 I integrate the ideas from Chapters 2 and 3, by proposing a preliminary framework to guide my empirical work, relating governance structure and MCS control solutions to the three cooperation control problems.

4.2. Conceptualising the relation between hybrid structure and MCS

Having developed a clearer understanding of the nature of hybrid structures and MCS control solutions, the next step is to conceptualise how these different control solutions interact with one another. Within the inter-organisational management control literature there appears to be a lack of clarity regarding the relation between different control solutions, such as hybrid structure and MCS, which may be working in combination (Anderson & Dekker 2010; Caglio & Ditillo 2008). The lack of clarity is a consequence, first, of a tendency for some studies to overlook the control capacity of hybrid structures, and second, of inconsistencies in the way researchers conceptualise and model the relation between hybrid structures and MCS.

4.2.1. Treating hybrids as context for control

One of the reasons it is challenging to understand the relation between hybrid structures and MCS is because prior studies have often overlooked the control capacity of hybrid structures. Rather than recognise the hybrid structure as a control solution in its own right; researchers have instead treated the hybrid arrangement as a context for control, including factors that describe hybrid elements as explanatory variables for MCS variation.

An example of this approach is by Van der Meer-Kooistra and Vosselman (2000) who use TCE to derive a comprehensive, contingency style model of management control of inter-firm relations. They predict the use of three different patterns of control within hybrids: market-based, bureaucracy-based and trust-based control⁸², which are enacted in three different stages of an inter-organisational relationship.⁸³ The authors' central argument is that variation in the patterns of MCS depends on the attributes of the transaction itself, the transaction parties, and the transaction environment. Putting aside issues relating to the complexity of their explanatory model⁸⁴, the inclusion of both party and environmental attributes represents an attempt to capture some of the broader variation that exists between different types of inter-organisational arrangements, such as the number of potential partners, the degree of symmetry in bargaining power between parties, or the availability of institutional rules. However, while these factors may potentially explain variation in MCS, and may even be associated with different types of hybrids, they do not actually describe structural features of hybrid governance modes. These attributes appear to represent hybrid-level antecedent variables that lead to cooperation problems (e.g. asymmetric bargaining power, degree of competition, information asymmetry), rather than explicitly modelling variation in the type of hybrid form and its influence on MCS.

This approach of considering the influence of hybrid-level explanatory factors, without explicitly accounting for the type of hybrid structure, can also be found in other studies that either use the Van der Meer-Kooistra and Vosselman (2000) framework (e.g. Donada & Nogatchewsky 2006; Johansson & Siverbo 2011; Langfield-Smith 2008; Langfield-Smith & Smith 2003) or some of its factors, such as 'prior partner experience' to model variations

⁸² Where market-based pattern control is reliant on regular use of measurement and evaluation of quantity and quality of output; bureaucracy-based control patterns use programmable mechanisms that focus on output and supervision, such as surveillance, evaluation and direction, and specified norms, standards and rules; and trust-based aims at developing trust between trading partners, (either goodwill or competence trust) (Van der Meer-Kooistra & Vosselman 2000).

⁸³ Rather than seeing the relationship as constitutive of multiple transactions, the authors appear to imply that the relationship encompasses a single transaction (and thus the relationship, and its control, progresses only once through stages of contact, contract and execution, rather than multiple times).

⁸⁴ Each of the three categories of contingency factors includes several elements, meaning that the model suggests patterns of MCS are determined by at least 15 different items. This seems overly complex and somewhat haphazard, as not all the relations between each contingent factor and MCS pattern are theorised, nor is consideration given for the different ways contingent factors may interact or combine.

in MCS (e.g. Dekker 2008). One problem of this approach is that while these studies indicate that MCS are influenced by broader contextual factors, they only proxy for differences in hybrid arrangements, rather than explicating the effect of different types of governance modes. Thus they only provide indirect evidence for understanding how MCS contribute to resolving cooperation control problems in different hybrid arrangements. In addition, this research runs the risk of flawed models of management control (Anderson & Dekker 2010), because if hybrid structures are acting as a first order control solution, then the research risks the omitted variable biases in examining the role of MCS. Because of these concerns, previous reviews of inter-organisational control have called for a more ‘combinative view’, advocating for investigating the simultaneous use of different control solutions exercised at different organisational levels (Anderson & Dekker 2010; Caglio & Ditillo 2008).

4.2.2. Alternative approaches to modelling the hybrid-MCS relation

A subset of studies has examined the role of hybrid governance structure and MCS simultaneously. However, these studies appear to have adopted one of two alternative conceptual approaches to model the relation between hybrid structures and MCS: typologies of hybrid-MCS archetypes and the modelling of hybrid misalignment.

Typologies of hybrid-MCS archetypes

The first way the relation between the hybrid context and MCS has been conceptualised in prior research is through typologies of hybrid-MCS archetypes. Previous studies explicitly specify different types of hybrid governance modes and the MCS expected to be used within each.

Perhaps the first example of this approach was by Speklé (2001), who developed a taxonomy of nine different ‘management control system archetypes’, spanning all three types of governance mode (market, hierarchy and hybrid). Each archetype was theorised to be supported by a distinct mix of MCS. Speklé identifies two types of hybrids.⁸⁵ *Hybrid*

⁸⁵ Congruous with TCE literature, Speklé describes both types of hybrids in having the long-term contracts (which enables compensation for durable transaction specific investments), and the added safeguards, such as hostage arrangements (cross-investment, joint asset ownership, penalty payments) or specialised arbitration.

arm's length control, represents situations such as outsourcing relationships, where buyers rely on a combination of residual market discipline and formal contractual safeguards, such as hostage arrangements, “that preserve autonomy but provide added transaction-specific safeguards compared to the market” (p. 430). In comparison, *hybrid exploratory control* relates to outsourcing relations with a limited number of suppliers. In these situations parties are predicted to use: emergent flexible contracts that become more detailed as the relation develops; social and relation control, based on close interaction and joint responsibility; high levels of information sharing; and market-based incentives, such as the use of comparative assessments between other suppliers.

Vosselman (2002) develops a similar predictive framework outlining the six different structural options for organising support activities⁸⁶, which each encompassed a unique configuration of governance mode and patterns of supporting MCS. Again, these six options span all types of governance modes – four describing different types of vertical integration modes and two relating to external procurement – and were differentiated by the relative degree of centralisation.⁸⁷ The two inter-firm modes represent the highest forms of decentralisation, and include an external buy-out, whereby a previously centralised unit is shifted external to the organisation; and more traditional outsourcing, with external market bidding and contracting. Both are suggested to be regulated through varying degrees of market competition, whereas in the external-buyout, managers may also regulate future transactions through offering long-term contracts and relational means with the entities new owners. However, perhaps because of Vosselman’s analytical focus on the role of top management, which is negligible in both these settings, he does not elaborate further on the additional bureaucratic mechanisms that may be found in these two forms.

A third example of this approach is Sartorius and Kirsten (2005) who suggest that different governing modes that could be used to organise sugarcane production would be supported by contractual arrangements with different control implications, including ex ante control,

⁸⁶ For example, accounting, cleaning, IT, maintenance and security.

⁸⁷ High centralisation is represented by two forms of hierarchical vertical management control structures (involving a high degree of control by top-management); moderate centralisation occurs in two hierarchical ‘horizontal’ models that incorporate internal supplier-client relations; low centralisation (decentralisation) occurs in the two models of external procurement.

ex post control, information sharing, and contract enforcement. For example, a ‘specification contracting mode’ – which is close to short-term, legally enforceable market based contracting – is expected to have moderate use of ex ante control, low to medium ex post control and information sharing. It contrasts more long-term formal cooperation modes, which place less emphasis on ex ante specification of contracts; however, as parties do not have the same ability to walk away, they place high importance on ex post monitoring and information exchange.⁸⁸

Finally, Kamminga and Van der Meer-Kooistra (2007) develop a framework predicting three patterns of management control used by parent organisations to control joint ventures. The authors argue that different relational characteristics describe variation in the nature of joint ventures, which in turn influences how the parents control the joint venture. They characterise joint ventures by both TCE transactional characteristics, as well as four different relational characteristics such as parental differences, information asymmetry, trust, and bargaining power. While these are similar to the characteristics used in other inter-organisational control studies, Kamminga and Van der Meer-Kooistra (2007) specify how combinations of these characteristics coalesce in different joint venture arrangements, characterised by their overall ‘control complexity’. The authors then argue that depending on the complexity of the joint venture, parent organisations will rely on one of three different patterns of control: content-based, consultation-based and context-based control. The authors differentiate between the three patterns using several aspects of MCS, including their intended target, focus and the specific type of mechanism. For example, for joint ventures with ‘low control complexity’ they expect the use of ‘content-based’ controls which are “mechanisms focused on the transactions” (p.137), where parents typically rely on bureaucratic mechanisms, such as formal agreements, approvals, boards, to directly intervene in the underlying activities of the venture. This contrasts ‘context-based’ controls (expected to be used in joint ventures with ‘high control complexity’), which are “control mechanisms focused on the relationship” (p.137), that are typically more “informal and

⁸⁸ The authors also describe a third hybrid variant sitting between these two examples – strategic alliance – which is expected to be medium term in length, have low ex ante control, and medium reliance on ex post monitoring and information exchange.

culture-based mechanisms and their essential purpose is to establish an organizational context suitable for the achievement of parent objectives” (p.137).

Reflecting on the overall value of the archetype approach used in all four of these studies, collectively they offer at least two key insights relevant to understanding the management of cooperation control issues in hybrid arrangements. First, they recognise that cooperation control problems can be addressed by a combination of *both* governance structure and the embedded MCS. Second, by introducing some variation in the type of hybrid within their frameworks, they also show that different types of hybrids require different types of MCS to support their operation. Although there may be similarities in the MCS (e.g. reliance on a degree of market competition) between different hybrids, the authors taking the archetype approach imply that for each hybrid we expect to see a distinct configuration of control systems.

However, there also appears to be at least two issues with this approach to MCS-hybrid relations. First, it is difficult to evaluate whether consistent patterns of MCS-hybrid configurations hold without further research into a wider range of hybrid types. As mentioned previously, the types of hybrids studied by control researchers represent only a narrow subset of the range of options listed in broader economic literature (see Section 3.3.4). This may also explain why empirical studies have found blends of ideal types in practice. For example, Nicholson, Jones and Espenlaub (2006) mobilise Speklè’s framework to categorise the generic⁸⁹ ex post⁹⁰ control practices and mechanisms they observe in the control of offshore accounting and finance vendors in India. They studied a range of governance modes used, including wholly owned foreign subsidiaries, vendor serving former parents, and third party arm’s length transactions. The authors argued the “importance of prior governance and ownership relationships in explaining control choices” (Nicholson, Jones & Espenlaub 2006, p.256), yet found, despite variation in governance

⁸⁹ Rather than the practices related to specific clients or transactions.

⁹⁰ Nicholson, Jones and Espenlaub (2006) describe control of a transaction event in three stages: contact, contract and control. They argue that while TCE assists in understanding the mechanisms used in contact and contract, management control theory is required to understand the mechanism used after the contract has been initiated.

arrangements, that all their individual cases used a range of control practices not restricted to a single archetype, and used blends of exploratory and arm's length components.⁹¹

Second, the MCS-hybrid archetype approach appears to make a problematic assumption about the relation between MCS and governance structure. In each study, the authors argue that variation in the entire hybrid-MCS archetype are predicted using the same transactional and/or relational antecedents. Although this approach includes governance structures as part of the control solution, it reduces the demarcation between the governance structure and the embedded MCS as separate or distinct choices. The authors appear to implicitly suggest that each different type of transaction would require its own architecture and MCS configuration. This may be problematic in explaining hybrids which facilitate more than one type of transaction, or for inter-organisational arrangements that change frequently over time.⁹² In addition, it also implies a one-to-one alignment between hybrid and MCS, which may be a limited perspective of the dynamic of the range of interdependencies that may exist between the choice of governance structure and embedded MCS.

Modelling governance structure misalignment

The distinction between the choice of governance mode and MCS is more evident in more recent inter-organisational management control research that considers the significance of a misalignment in governance structure (Anderson & Dekker 2005; Dekker 2004; Johansson & Siverbo 2011; Phua, Abernethy & Lillis 2011). This research builds from theoretical implications of TCE theory that has developed in parallel in broader economic research. Thus, in this section, I will first explain the economic theory of misalignment before examining how this has been applied in inter-organisational control accounting research.

The notion of *alignment* is fundamental to TCE theory. TCE theory expects an efficient alignment between the transactional context, which gives rise to cooperation problems that

⁹¹ Their results also revealed the use of both *boundary controls*, such as standards and standardisation, limits of authorisation, security, codes of conduct, *machine and exploratory controls*, such as financial reporting, performance benchmarking, direct interaction between staff, as well as *arm's length control*, such as contractual gain sharing and arbitration procedures.

⁹² Kamminga and Van der Meer-Kooistra (2007) show their model can explain changes in joint venture relationships over time; however, these changes occur over the course of several years – a sufficient span during which MCS could be adjusted. It is not clear whether the model could apply for transactional environments where changes occur more rapidly and frequently.

vary in their severity, and the type of control solutions, which vary in their costs and capabilities⁹³ (Williamson 1985, 1991). Even though TCE is an equilibrium theory – it expects competitive pressures to ensure governance structures converge towards equilibrium in the long-term – in assuming bounded rationality of human managers, it also accommodates the possibility of misalignment in the short-term (Williamson 1985). Sampson (2004) suggests that hybrid governance structures may be misaligned to transactional hazards because decision-makers do not fully anticipate contractual hazards, because they rely on heuristics that are subject to bias, or because hubris or overconfidence leads them to overestimate their ability to handle contractual hazards. Governance misalignment may occur in two alternative ways. First, through the selection of a governance structure that does not provide adequate safeguards for relatively high levels of contractual hazard, thus exposing parties to the cost of unmitigated opportunism. Second, through the selection of an unnecessarily intensive governance mode for relatively low contractual hazards that introduces the costs of excessive bureaucracy (Sampson 2004; Williamson 1985). As Leiblein, Reuer and Dalsace (2002, p. 821) explain:

...for complex exchange relationships involving transaction specific investments, a firm that selects a simple governance structure lacking adequate safeguards will be exposed to moral hazard and hold-up risks. By contrast, the potential consequences of adopting an excessively complex governance structure for a simpler relationship include a loss in flexibility and decision-making speed due to the imposition of bureaucratic controls.

Economic research has also shown governance structure misalignment to have significant performance effects for inter-organisational R&D activities. Leiblein, Reuer and Dalsace (2002) examine the effects of outsourcing decisions (i.e. to make or buy) of technological performance in the semi-conductor industry. They find that while there were no absolute

⁹³ TCE is primarily concerned with efficiency, and assumes that economic behaviour and organisation is driven by a need for activities and organisations to be ‘efficient’ rather than wasteful (Williamson 1991, 2008). Williamson (1991) differentiates between the ‘allocative efficiency’ (relating to the efficient allocation of resources across an economic system) and ‘organisational efficiency’ (the effective use of discrete structural alternatives), with the former associated with price mechanisms and the latter with structural alternatives. This latter form of efficiency is threatened whenever unanticipated changes or ‘disturbances’ occur. As such, TCE takes ‘adaptation’ (i.e. the coping or adjustment to change in order to return to equilibrium) to be the central economic problem and the main purpose of organisation (Williamson 2008, 2010).

performance differences between firms that chose to organise development activities in-house and those that relied on external contractors, the arrangements which deviated from what was the expected ‘optimal form of governance’ suffered a loss in expected technological performance. The authors found that ‘governance misfit’ had a negative impact of technological performance in situations when firms choose to outsource activities that exhibit characteristics associated with relatively high contractual hazards (i.e. excessive opportunism).

A later study by Sampson (2004) also observed the detrimental effect of governance misalignment on technological performance. Whereas Leiblein, Reuer and Dalsace (2002) studied the alignment of internal vs. external production, Sampson (2004) examined the implications of misalignment between different types of hybrids. Studying the use of pooling contracts and equity joint ventures in the telecommunications equipment industry, Sampson demonstrated that the choice of governance generally aligns to TCE theory where allying firms choose equity joint ventures for transactions that have relatively high contracting hazards (e.g. when there are a higher number of partner firms, broader scope of activities, and when ‘appropriability regimes’ are weak). In addition, she shows that the selection of an ‘aligned’ governance structure⁹⁴ results in substantially higher technology performance⁹⁵, demonstrating that “misaligned governance exacts a toll on collaborative benefits from R&D alliances” (p.519).

Furthermore, Sampson (2004) found that the cost of governance misalignment is asymmetrical, in that the relative size of the performance effect was different depending on the type of misalignment. The selection of an equity joint venture in a low hazard scenario (excessive bureaucracy) results in a substantially larger negative impact on technological performance than using a pooling contract in high hazard situations (excessive

⁹⁴ Sampson tests the performance effects of alignment using a two-stage regression model, whereby she estimates the governance selection model (the probability of selecting a given governance structure) and then the collaborative benefits under each governance mode as a function of variables including technological and alliance attributes.

⁹⁵ Sampson measures technological performance using a weighted index of patent citations. She finds that “alliances that are selected according to transaction cost arguments improves collaborative benefits substantially by an average of 138% over governance not so selected” (Sampson 2004, p.486).

opportunism).⁹⁶ Sampson provides two interpretations of these results. The first was that in the context of R&D, the costs of bureaucracy, such as the cost of increased management, the dampening effect on innovation and the reduced pace of decision-making is much more problematic than any loss in performance that occurs as a result of uncontrolled opportunism. The second interpretation was that the realised costs of uncontrolled opportunism may not be as substantial as expected; “partners have implicit means of protecting against free riding and leakage when contracting is difficult that substitute for the more formal mechanisms of the equity joint venture” (Sampson 2004, p.522). Although the research design did not test for the existence of these implicit mechanisms⁹⁷, the relatively low performance impact of governance misalignment in relation to contracting hazards suggests that “firms utilize implicit controls that may compensate for the inability to fully contract to reduce risks of leakage” (p.520).

This last line of reasoning from Sampson (2004) is particularly salient for inter-organisational management control research. First, it aligns with observations of the use of hybrid arrangements even in situations of moderately severe hazards (Anderson, Glenn & Sedatole 2000; Nicholson, Jones & Espenlaub 2006; van den Bogaard & Speklé 2003). Second, it provides indirect evidence that MCS may be used to compensate for governance misalignment by providing additional safeguarding against contractual hazards.

In the accounting literature, the notion of misalignment between control solutions and cooperation control problems was first raised by Dekker (2004). Although he did not explore the issue in his empirical material⁹⁸, Dekker predicted that one explanation for

⁹⁶ That is Sampson’s results show that in low hazard cases, firms that select equity joint venture could have achieved improvements in performance of 307% if they had chosen a pooling contract; whereas in high hazard situations, firms that selected pooling contracts could have improved performance by 4% if they had selected an equity joint venture structure.

⁹⁷ “Such controls are implicit, in the sense that they are not expressly included in the alliance agreement even though the existence and importance of these controls are likely well understood during the initial alliance negotiation process” (Sampson 2004, p.520).

⁹⁸ Dekker (2004) raised the issue of misfit in discussing his approach to testing the explanatory power of his framework. He investigated the degree to which proposed linkages between control problem and control solution variables corresponded to observations in his case study. That is, if the governance structures were not suitable to address the control problems, he would have expected to see declining performance. However, he also conceded that “with the current data it is impossible to assess the longer-term performance effects of the alliance, although this possibility did not seem to be the situation” (p.42).

“when an alignment or ‘fit’ between control problems and governance structure is not found, is that a misfit exists, which over time would result in an escalation of control problems in the alliance and declining or lower performance” (Dekker 2004, p.42).

Anderson and Dekker (2005) investigate the performance effects of misalignment, albeit in reference to the misalignment of contractual designs rather than choice of governance structure. They suggested that:

... for a given legal setting and given ex ante contracting costs, inter-organizational management control structures are designed in response to transaction characteristics. We further hypothesize that misalignment between the transaction context and the control structure is associated with subsequent transaction problems. (Anderson & Dekker 2005, p.1734).

Using data from a cross-sectional survey of 858 information technology (IT) outsourcing transactions, they captured information about contract design, transactional qualities and the extent to which 11 problems occur in period after installation (i.e. evidence of ex post problems). They were able to provide evidence supporting their hypothesis, finding that “contract structures that fit the circumstances of the transaction less well than others experience greater incidence of problems than transactions with aligned contract structures” (Anderson & Dekker 2005, p.1747).

In their study of exit barriers to inter-firm control choices, Phua, Abernethy and Lillis (2011) argue that misalignment in control choices may arise because of the switching costs associated with changing extant governance structures, including the opportunity costs arising from benefits forgone when discarding existing controls, and the reinvestment costs to establish control over new transactions with new suppliers. Presuming that these switching costs are significantly large, they argue firms will be impeded in having optimal governance structures; specifically “when switching costs incurred to establish alternative governance structures are high, it may be more efficient for firms to continue to use extant governance structures that are not optimal” (Phua, Abernethy & Lillis 2011, p.1798).

The authors argue that control choices vary in the expected switching costs, which they empirically examine by comparing the relative ease of switching suppliers on the basis of

their initial governance choice. Although there is some concern that their results may also be driven by the effect of asset specificity⁹⁹, they find that “as hypothesized, observed patterns across 53 cases show that firms with trust-based controls experience the most difficulty in switching suppliers; firms with market-based controls experience the greatest ease; and firms with bureaucratic-based controls and hybrid controls lie between these extremes” (Phua, Abernethy & Lillis 2011, p.1797). Overall their results provide support for the notion that, at least in the short-term, organisations may not achieve the optimum alignment between the cooperation hazards of a given contracting relation and control solutions.

The most comprehensive accounting study of misalignment is by Johansson and Siverbo (2011) who relate the notion of misalignment in the choice of governance mode to the choice of MCS. Johansson and Siverbo (2011) reason that, following an extended make or buy decision (Van der Meer-Kooistra & Vosselman 2000), a party requiring goods or services may first decide to choose an outsourcing mode and then also select the internal governance mechanism – the MCS – within the arrangement. They suggest that misalignment in the choice to outsource may occur because of factors such as “lack of information, misunderstandings or purely random choices...for ideological and political reasons or as a consequence of different forms of institutional pressures, i.e. forced selection, fad and fashion” (Johansson & Siverbo 2011, p.297).

Similar to Leiblein, Reuer and Dalsace (2002), Johansson and Siverbo (2011) examine two different types of misalignment relating to outsourcing choices:

Either the wrong choice is to ‘buy’ when the right choice is to ‘make’, or the reverse. The former situation arguably creates additional cooperation hazards in the form of increased exposure to opportunism and risks of hold-up and fundamental transformation. (Johansson & Siverbo 2011, p. 297)

⁹⁹ The authors find that asset specificity is highly correlated with ease of switching suppliers (−0.638***), as well as choices of control patterns. Furthermore while in logit regression, the control choices are associated with ease of switching; however, they become non-significant when asset specificity is included in the model. The authors acknowledge that “these findings seem to suggest that asset specificity, and not control choice, is the only significant predictor of the ease of switching suppliers. While we acknowledge that asset specificity determines both control choice and the ease of switching suppliers, we expect that control choice will have an incremental effect on the ease of switching suppliers” (Phua, Abernethy & Lillis 2011, p.1810).

Like Anderson and Dekker (2005), Johansson and Siverbo (2011) expect misalignment in governance choices to affect subsequent performance. However, the key feature of their study is that they predict the misalignment to affect the amount and type of control required for ensuring cooperation and protecting against cooperation hazards. That is, in situations when the initial choice of outsourcing does not align to transactional characteristics, there are heightened cooperation hazards stemming from misalignment; this necessitates the more intense use of MCS as an additional safeguard. They argue that in situations where an organisation has over-(under-) outsourced¹⁰⁰ you would expect to see a more (less) intense use of MCS.

Using a two-step regression¹⁰¹ approach, they analyse survey data collected about outsourcing decisions made by public sector organisations. Structuring their sample into three clusters, their findings revealed in one cluster with high competition and high dependence, organisations tend to over-outsource; this is accommodated by use of market-selection processes and intense use of control. In another cluster where there is weak competition and low dependence, organisations tend to under-outsource, which the authors interpret as a cautious approach to outsourcing – these organisations also do not have to use controls intensely. The authors interpret both these results as confirming their expectations. They surmise that in order to deal with cooperation control problems, organisations first decide the degree to which they outsource, and then adjust the intensity to which they use MCS to manage any residual hazards.

This collection of studies provides support for the notion that MCS relate to hybrid governance by compensating for the misalignment that occurs in the choice of governance mode. Together they provide evidence that misalignment can occur between control problems and control solutions, either because of some form of bounded rationality on the

¹⁰⁰ ‘Over-outsourcing’ is when organisations outsource certain activities which on average display characteristics more suited to hierarchical governance (‘misalignment towards buy’), whereas ‘under-outsourcing’ is when organisations keep internal certain activities which on average display characteristics more suited to market governance (‘misalignment towards make’).

¹⁰¹ They use a two-step regression model to predict the expected degree of outsourcing across the entire sample of organisations, based on their responses regarding degree of competition, dependence and degree of outsourcing.

part of the manager, or because of the cost of switching from pre-existing control choices. In addition, they show that misalignment has negative consequences, such as a loss of performance outcomes or more severe ex post control problems. Finally, it appears that misalignment in the choice of governance is associated with more intense use of MCS to compensate. However, to date no single study has explored the role of MCS in the context of misalignment in hybrid choice. Also, it is not yet clear how, besides the level of intensity in use, MCS operate to compensate for misalignment between hybrid structures and different types of control problems. Thus, there remains substantial scope to explore how the choice of different hybrid structures interacts with the choice of MCS, and how MCS actually operate to compensate for governance misalignment.

4.2.3. Summary

In summary there are three different conceptual approaches used in the inter-organisational management control literature to model the relation between the hybrid context and MCS. While early attempts included more rudimentary hybrid-level explanatory factors of MCS (e.g. party and environmental characteristics), later studies have provided more explicit recognition of the choice of governance structure, either by including structural features of different hybrid structures in their models of MCS (as in the archetype approach) or by modelling the choice of governance separately from the choice of MCS.

The latter two approaches suggest two alternative ways MCS may relate to the choice of hybrid structures in addressing cooperation concerns. Studies using the archetype approach suggest that MCS will be driven by the need to facilitate the operation of the hybrid, and thus will be designed to support the specific structural characteristics. In contrast, the misalignment approach suggests that MCS will play a compensatory role, in that MCS choice will be framed not by the structural features of the governance structure per se, but rather the adequacy of the governance structure to address cooperation hazards presented by a given transaction. Thus, in order to more clearly understand how the choice of different governance modes interacts with the use of embedded MCS, we need to study more closely how hybrid structures and MCS actually operate, over variation in the hybrid arrangement.

4.3. Relating control solutions and problems in inter-organisational R&D exchanges

In the final section of this chapter I explain how insights from the prior literature can be used to frame the conceptualisation of control solutions, specifically in relation to the cooperation control problems of inter-organisational R&D exchanges. This final step is necessary because the notion of a ‘control solution’, as opposed to simply a control system or structure, is only meaningful in the context of the control problem that it addresses (Vosselman 2012). I will outline the key conceptual elements derived from the previous two chapters, and explain how they may relate in a preliminary framework, which is summarised in Figure 1 below. The discussion which follows details the way this framework has been constructed, including the selection of the overarching dimensions and the key constructs. Embedded in this discussion I will also attempt to identify the focal relations between the constructs and to draw attention to the specific areas and questions which remain to be explored. These will form the focus of the empirical investigation and subsequent theoretical analysis.

There are two key dimensions framing the overall scope of the study. The first dimension is the interaction between control problems and solutions. Specifically, in this study I seek to explore the way ‘cooperation control problems’ – the various risks presented when contracting parties act in their own interest to the disadvantage of the other – are addressed by organisational responses or ‘control solutions’ (Caglio & Ditillo 2008). The second dimension is the three phases of contracting, which is derived from Van der Meer-Kooistra and Vosselman (2000). When combined, the two dimensions suggest three focal sites whereby the interaction between cooperation control problems and solutions may occur throughout the duration of R&D exchange, including the *ex ante* or pre-contract stage, at the point of contract itself, and *ex post* in the execution and fulfilment of the contract.

The next consideration is the nature of the cooperation control problem at each of the three contracting phases. As described in Chapter 2, I propose the emergence of three different types of cooperation control problems, including the negotiation of mutually agreeable project contracts; the selection and investment project decision; and ensuring compliance with the contract. Based on TCE theory, these three problems are suggested to arise out of the combination of behavioural assumptions and transactional attributes likely to be found in each stage of an R&D transaction.

To conceptualise the nature of control solutions, I draw on existing inter-organisational MCS research and economic literature to suggest that inter-organisational cooperation control problems are addressed by MCS as well the governance structure that they are embedded within. Consistent with the logic of the ‘extended make-or-buy’ decision (Van der Meer-Kooistra & Vosselman 2000), I conceive of control solutions as constituting the outcome of a series of interdependent control choices existing at different levels of analysis (Anderson & Dekker 2010; Caglio & Ditillo 2008). Although it may be possible to both observe and categorise these different control choices, particularly the MCS, at an even high level of granularity (Anderson & Dekker 2010), for the sake of analytical parsimony I partition the control solution into just two components – the governance structure and MCS.

In terms of the governance structure control solutions, I propose that in an inter-organisational environment, R&D transactions may be administered by any one of a number of different types of hybrid structures. While existing MCS research has tended to conceptualise hybrids in narrow terms, I follow more recent economic literature to consider that hybrids may manifest in a much more extensive range of organisational forms. In addition, this literature also suggests that hybrids can be differentiated by their structural characteristics, such as the degree to which they rely on formalisation, centralisation and relational governance. Thus, in exploring the role of (different) hybrid structures as a first-order control solution to cooperation control problems in inter-organisational R&D exchanges, I will explore the nature of hybrids' structural features and explain how these structural features enable the hybrid to address each of the three potential cooperation problems that may arise.

To identify the embedded MCS control solution components, I refer to the general conception of MCS being the systems, processes and mechanisms put in place to ensure the hybrid's objectives are achieved (Langfield-Smith 2008, p.345). Following my review of prior literature, I consider the existence of different types of MCS within hybrids including planning mechanisms, monitoring and reporting systems, incentives, and social-based mechanisms.

My analysis will focus on examining whether there are consistent patterns in how various MCS operate to facilitate particular structural characteristics that differ between hybrid arrangements (as suggested the hybrid-MCS archetype approach). In addition, the analysis will also examine the balance of control solution components in addressing the control problems. While earlier studies indicate that MCS may be used more or less intensively, depending on the degree of statistical fit between the choice of outsourcing and the overall severity of cooperation hazards (Anderson & Dekker 2005; Johansson & Siverbo 2011), I will seek to directly study occurrences of misalignment between the hybrid structure and three different types of cooperation problems. In addition, I will also explore not only the extent of MCS use, but the operation of how MCS are used to compensate for misalignment.

4.4. Chapter summary

In this chapter I have conceptualised the relations between the different constructs of the study: between control solutions; and between control solutions and control problems.

In Section 4.2, I explored the relation or inter-dependency between control solutions, specifically between hybrid structure and embedded MCS. My analysis of how previous inter-organisational control studies have accounted for the hybrid-MCS relations revealed several conceptual approaches. First, studies have included more hybrid-level explanatory factors of MCS. This approach does not recognise the control capacity of hybrid structures, and instead models the hybrid-MCS relation as between the inter-firm context and control solutions. Second, some studies have viewed hybrid structure and MCS as forming distinct combinations of control solutions - which I label the 'archetypal approach'. Third, some studies model the choice of governance as a separate precursor to the choice of MCS, whereby MCS is used to provide incremental safeguarding in situations of structural misalignment to control problems. I label this the 'misalignment approach'. These alternative approaches to conceiving the hybrid-MCS relation all provide a different explanation for why MCS will be influenced by the choice of hybrid governance structure.

In Section 4.3 I draw together the different conceptual elements presented in Chapters 2 and 3 to construct a preliminary conceptual framework explaining how hybrid structure and embedded MCS control solutions address cooperation control problems in inter-organisational R&D exchanges. This framework comprises the three cooperation control problems (occurring at three contractual phases) which I propose will be addressed by a combination of inter-dependent control solutions. These control solutions include the type of hybrid arrangement, which is characterised by a combination of formalisation, centralisation and relational governance, as well as embedded MCS mechanisms, including planning, monitoring and reporting systems, incentives and social-based systems.

This preliminary conceptual framework forms the basis of my empirical investigation and subsequent theoretical analysis. In the following chapter I explain the series of inter-dependent choices that shaped both the design and implementation of the empirical component of this study.

Chapter 5: Research method

5.1. Introduction

The aim of this chapter is to describe and justify the multiple-case study approach used to gather and analyse empirical material used to address the study's research question. The chapter is structured according to the series of inter-related choices I have made concerning the design and implementation of this empirical approach. First, in Section 5.2 I discuss the methodological assumptions – broadly congruent with a postpositivist stance – that have shaped the broad design of the study. This is followed in Section 5.3 by a detailed description of the research strategy, including the use of abductive approach to theory development; the justification for a qualitative case study method and multiple-case design, and the rationale for selecting the CRDC and Cotton CRC as case studies. Finally in 5.4 I detail the considerations relating to the collection and analysis of interview, observational and archival data for each of the two cases.

5.2. Methodology

The study was shaped by methodological assumptions broadly congruent with a postpositivist stance (Creswell 2007; Guba & Lincoln 1994; Patton 2002). 'Postpositivism' describes a range of approaches that are similar to positivist inquiry, but have been modified to address its perceived weaknesses¹⁰², particularly in its application to social research (Creswell 2007; Guba & Lincoln 1994; Patton 2002). The aim of this inquiry is to develop empirically-based causal explanations which are internally and externally valid, and can be related to knowledge from prior research (Guba & Lincoln 1994). This is accompanied, however, by the recognition "that discretionary judgement is unavoidable in

¹⁰² More fundamental positivism is characterised by the application of ideals, assumptions and procedures from natural science, encapsulating the pursuit of 'scientific knowledge', such as universal laws, "through empirical verification of logically deduced hypotheses with key concepts and variables operationally defined and carefully formulated to permit replication and falsification" (Patton 2002, p.92). This approach has been criticised for several reasons including, but not limited to: the tendency to 'strip' context in order to develop more comparability in research designs; the disjunction between emic and etic; the reduced potential for discovery; the under appreciation of the role of values and (socially constructed) theory to interpret phenomenon; and questions about the true independence of the researcher and the researched (Guba & Lincoln 1994).

science, that proving causality with certainty in explaining social phenomena is problematic, that knowledge is inherently embedded in historically specific paradigms and is therefore relative rather than absolute” (Patton 2002, p. 92). As a broad category Guba and Lincoln (1994) suggest that postpositivism can be characterised by ontological¹⁰³ and epistemological¹⁰⁴ assumptions from critical realism. In the following paragraphs I elaborate in more detail about the specific nature and implications of the assumptions I have applied in this study

Broadly speaking, a realist stance implies assuming the existence of a real world independent of our knowledge of it (Blaikie 1993; Bryman 2004; Patton 2002; Sayer 2000).¹⁰⁵ More fundamental positivist work adopts a ‘naïve realist’ stance, which assumes a singular, ‘perfectly apprehendable’ reality, driven by immutable natural laws and mechanisms that can be readily observed and known (Guba & Lincoln 1994). However, in this study I have taken a more ‘critical realist’ stance, which accepts the existence of some reasonably stable and mind-interdependent reality but “does not see empirical observations as direct, or unmediated reflections of some underlying reality” (Modell 2005, p.212). This form of realism – also known as ‘social realism’ (Blaikie 1993) or ‘transcendental realism’ (Bhaskar 1998) – recognises that social phenomena, even those that are socially constructed¹⁰⁶ such as organisations, MCS or transactions, exist independently of our identification or knowledge of them.¹⁰⁷ However, this stance also assumes that researchers

¹⁰³ Ontology refers to assumptions about “the form and nature of reality, and therefore, what is there that can be known about it” (Guba & Lincoln 1994, p. 108).

¹⁰⁴ Epistemology refers to assumptions about “the nature of the relationship between the knower or would-be knower and what can be known” (Guba & Lincoln 1994, p.108). This obviously is influenced by a researcher’s ontological assumptions.

¹⁰⁵ Blaikie (1993) describes a realist ontology as “concerned with a reality that is claimed to exist and act even if it has not yet been observed, and this reality has a life of its own apart from the activities of science...Realism claims that the entities, states or processes described by theories really do exist” (p.58).

¹⁰⁶ As Miles and Hubermann (1994, p. 4) explain “social phenomena, such as language, decisions, conflicts and hierarchies, exist objectively in the world and exert strong influences over human activities because people construe them in common ways. Things that are believed become real and can be inquired into”. Bhaskar (1998) uses the idea of stability to distinguish between ‘transitive objects’ – which are the concepts, theories and models which are developed by science to describe, explain reality, but can change over time; and, ‘intransitive objects’ – which are the real entities, structures and relations that exist in the natural and social world.

¹⁰⁷ More specifically a critical realist view of reality is based on a ‘stratified ontology’ whereby reality is presumed to consist of three different but overlapping domains (Bhaskar 1998). First is the domain of *real* objects and mechanisms that exist independent of individual human beings. Real objects and mechanisms

access of reality is always filtered through their own theoretical lens (Fleetwood 2005). This position aligns to the perspective of Miles and Hubermann (1994), who acknowledge that social phenomena can exist in the objective world (as well as in the mind) and that ‘lawful’ and ‘reasonably stable’ relations can be found among them:

The lawfulness comes from the regularities and sequences that link together phenomena. From these patterns we can derive constructs that underlie individual and social life. The fact that most of those constructs are invisible to the human eye does not make them invalid.
(Miles & Hubermann 1994, p.4)

Within the corresponding epistemology, the aim of social science is to build rational, causal conceptual models – describing the relations between underlying structures and mechanisms – which account for regularities in the observable phenomenon being empirically examined (Blaikie 1993). As this stance shares positivism’s intent to develop theoretical explanations, researchers approach empirical material maintaining a belief that “it is possible, using empirical evidence, to distinguish between more and less plausible claims, to test and choose between rival hypotheses, and to distinguish between belief and ‘valid belief’” (Patton 2002, p.93). Thus, they maintain a concern for using systematic empirical procedures to develop valid causal explanations (Creswell & Plano Clark 2007; Patton 2002).

However, compared to positivists, realists hold a more qualified view of the types of knowledge claims researchers can make. The following passage from Keat and Urry (1975, p. 5) is instructive in understanding this difference (emphasis added):

The realist shares with the positivist a conception of science as an empirically-based, rational and objective enterprise, the purpose of which is to provide us with true explanatory and predictive knowledge of nature. But for the realist, unlike the positivist, there is an important difference between explanation and prediction. And it is explanation that must be pursued as the primary objective of science. To explain phenomena is not

tend to be stable and durable over time; however, they may not always be perceived by human cognition (e.g. atoms). Second, is the domain of the *actual*, where events occur based on the generated, causal powers embedded in real mechanisms; again these may or may not be observed. Third is the domain of *empirical*, which is made up of the experiences and observations of either objects or events produced by those objects (Blaikie 1993, 2010; Modell 2005; Sayer 2000).

merely to show they are instances of well-established regularities. Instead, we must discover the necessary connections between phenomena, by acquiring knowledge of the underlying structures and mechanisms at work. Often, this will mean postulating the existence of types of unobservable entities and processes that are unfamiliar to us: but it is only by doing this that we get beyond the 'mere appearances' of things, to their natures and essences. Thus, for the realist, a scientific theory is a description of structures and mechanisms which causally generate the observable phenomena, a description of which enables us to explain them.

This implies that although realist researchers consider objectivity the 'regulatory ideal' (Guba & Lincoln 1994), they concede that it is not possible to verify their findings in any 'objective' sense (Modell 2005). Instead scientific knowledge claims are seen as only contingently stable and context-bound, and always potentially fallible (Guba & Lincoln 1994; Modell 2005; Patton 2002). In addition, as realists recognise that their explanations describe the tendencies, rather than immutable laws, of potentially unobservable mechanisms, they also are required to subject their claims to critical examination (Blaikie 1993; Guba & Lincoln 1994). In particular, they need to account for how their explanations are affected by the context-specific nuances of "the particular configuration at hand" (Miles & Hubermann 1994, p.4).

Postpositivists are also hesitant in applying natural science methods and procedures to social science. They suggest that although it is possible for social science to share the principles of natural science, because its subject matter is fundamentally different – in that social phenomena cannot be reduced and decomposed in the same way a natural science phenomenon can – social objects cannot be studied the same way as natural objects (Bhaskar 1998; Blaikie 1993). Researchers often favour more qualitative approaches over more controlled experimentation, as this enables deeper understandings of a phenomenon in its context and consideration of the meanings and purposes people ascribe to their actions (Guba & Lincoln 1994; Miles & Hubermann 1994; Patton 2002).

A postpositivist methodology was chosen for this study, first because it aligns with my objectives and choice of theory. A postpositivist stance fits my aim of inquiry, which is to develop causal explanations about why certain organisational structures and management

mechanisms are used in inter-organisational R&D exchanges. In addition, a realist stance is required in order to apply existing theory from MCS and TCE literature to develop those causal explanations, as both are based on an ‘ostensive, rationalist, modernistic’ perspective, with a focus on detecting and explaining order and stability (Vosselman 2012).

Second, compared to more traditional positivist approaches, postpositivism better accommodates my use of theory in explaining empirical phenomenon. In particular, by taking a realist stance I can account for the distance between phenomena in reality and the theoretical frameworks I apply. This distance manifests in language, specifically the ‘emic’, which is the language and categories used by ‘insiders’, such as the people being studied, and the ‘etic’ which are the categories and constructs of ‘outsiders’, such as researchers (Patton 2002). For example, in this study interviewees provide emic accounts describing specific issues they have faced in negotiating research proposals, which I describe using my etic perspective as ‘opportunism’.¹⁰⁸ In addition, the postpositivist assumptions also account for a distance between abstract concepts and explanations from theory and patterns of phenomena in reality. For example, in this study I am concerned with the interaction between the constructs of ‘control problems’ and ‘control solutions’. These constructs are not directly or readily observable in reality, rather they are mechanisms and structures derived from a combination of TCE and MCS theory. Nonetheless, these constructs may be useful in describing patterns in observable managerial responses to problems that exist in inter-organisational R&D situations, separate from my own observations of them.

5.3. Research strategy

A research strategy outlines the plan for how empirical material will be used to develop explanations that address the study’s central research question (Bryman 2004; Creswell 2007; Patton 2002). In this thesis, my research strategy is comprised of four elements: an abductive approach to theory development, a qualitative case study method, a multiple-case design, and the selection of the two case studies.

¹⁰⁸ Similar language differences exist in the description and classification of MCS and hybrid structures.

5.3.1. *Abductive approach to theory development*

The first feature of my research strategy is an abductive approach to theory development. Although researchers have often characterised theory development approaches as either deductive or inductive, a third alternative is an abductive approach¹⁰⁹ (Peirce 1960). Whereas deductive approaches develop theory *a priori* based upon premises from existing literature, and inductive approaches develop theory from empirical observations, abductive approaches start with the observation of a surprising phenomenon, followed by the application and refinement of existing theory, to explain what has been observed (Blaikie 1993, 2010; Bryman 2004; Dubois & Gadde 2002; Patton 2002).¹¹⁰ As Modell (2005, p.213) explains:

In contrast to the hypothetic-deductive mode, pivoting on empirical testing of hypotheses derived from extant theories, abduction is about developing theoretical explanations based on emerging empirical observations. However, it does not move directly from empirical observations to theoretical inferences, as is the case in pure inductive research, but relies heavily on theories as mediators for deriving explanations.

The three approaches to theory development also differ in their use of theory. Whereas deductive approaches are suited to the *testing* of established conceptual models (Patton 2002), the open-ended grounded nature of inductive approaches are more appropriate to the *generation* of new theoretical concepts and explanations (Eisenhardt 1989; Eisenhardt & Graebner 2007). In abductive approaches, the iteration between the empirical observations and explanation from existing concepts supports the *development* and *refinement* of existing theoretical frameworks (Dubois & Gadde 2002).

In my study, I adopt an abductive approach to refine theory from the TCE and MCS literatures. The previous three chapters have reviewed the existing literature that informs the nature and causes of the potential cooperation control problems in inter-organisational R&D exchanges, as well as the range of potential control solutions; however, it is not

¹⁰⁹ Stemming from its original formulation by American philosopher Charles Peirce, abductive reasoning is also referred to 'retroduction' (Blaikie 1993; Modell 2005).

¹¹⁰ Perhaps the most famous example of abductive reasoning is Kepler's discovery of how the planets move in elliptical orbits, which he developed through a long process of empirical observation and reflection until he developed a theory to fit his observations (Blaikie 1993).

possible to formulate hypotheses that are suitable for testing about the relation between cooperation control problems and control solutions in inter-organisational R&D exchanges. This is because further empirical work is required, for example, to explore if the three cooperation control problems are valid descriptions of managerial challenges in reality, and to discern the most suitable way of characterising and categorising the MCS embedded within different hybrid arrangements. Furthermore, it is difficult to develop meaningful predictions about the relation between control problems and solutions without first understanding the nature of the interdependencies between different types of control solutions (i.e. between the choice of hybrid governance structures and MCS). By using an abductive approach, I hope to address, develop and refine the theory from TCE and MCS literature so that they become more amenable to testing in future research.

To further understand how I could develop theory using an abductive approach, I refer to Blaikie (1993) and Modell (2005), who describe a general research process that is congruent with the postpositivist methodological assumptions described earlier.¹¹¹ After initially observing patterns in phenomena (e.g. the use of various management systems in inter-organisational R&D settings), researchers then develop explanatory theories by postulating the existence of underlying mechanisms and structures (e.g. ‘control problems’ and ‘control solutions’) that could have produced such patterns. Although these mechanisms and structures are believed to be ‘real’, they may not be observable, and thus in developing theory, researchers draw upon existing and familiar sources (Modell 2005) such as prior conceptual frameworks (e.g. TCE theory). The latter stages then focus on establishing the plausibility of the explanation. This is accomplished by additional testing using alternative measures or instruments, by postulating the logical consequences of the explanation and finding corroboratory empirical evidence, or by eliminating alternative explanations (Blaikie 1993). I provide more detail about how this general abductive process manifests in the operational procedures of this study in Section 5.4.

¹¹¹ This research process appears to be similar to what Miles and Huberman (1994) refer to as ‘analytic induction’, which also aligns to the inductive approach described in some forms of Grounded Theory (Strauss & Corbin 1990). However, unlike purer inductive approaches, abductive (or ‘retroductive’) approaches are characterised by the application of existing theoretical concepts (Blaikie 1993, 2010).

5.3.2. Qualitative case study method

The second feature of my research strategy is the use of a qualitative case study method. Creswell (2007, p. 73) defines the case study method as “a qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection, involving multiple sources of information”. Central to this definition are two characteristics of case study approaches: depth and boundaries. Case research is characterised by an emphasis on understanding the depth and complexity of a specific setting, through close study of a phenomenon embedded within its context (Yin 2003). The aim of this mode of inquiry is to the “study of the particularity and complexity of a single case” (Stake 1995, p.xi), “describe that unit in depth and detail, holistically, and in context” (Patton 2002, p.55), and understand “the dynamics present within single settings” (Eisenhardt 1989, p.534). To balance the depth of inquiry, case studies are also denoted by the establishment of boundaries (Creswell 2007), where a ‘case’ is viewed as a “specific bounded system” (Patton 2002; Stake 1995). These boundaries are formed through choices about what actors, activities, organisations or time periods will and won’t be included in the study (Dubois & Gadde 2002; Miles & Huberman 1994). Operationally, the combination of depth and boundaries means that case study approaches tend to involve the collection and analysis of multiple sources of evidence (Creswell 2007; Patton 2002; Stake 1995; Yin 2003) concerning a clearly defined object of study (Patton 2002).

There were three reasons why I chose a case study method for this study. The first reason why a case study appeared an appropriate method choice was the nature of the study’s research questions and aims. Generally, a case study method is considered appropriate when a ‘how’ or ‘why’ question is being asked (Yin 2003), particularly when the researcher intends to examine unexplored research areas (Eisenhardt & Graebner 2007). This is because these sorts of questions “deal with operational links needing to be traced over time, rather than mere frequencies or incidence” (Yin 2003, p.6). Case studies are well suited to study these operational links because of the variety of data collected and the ability to observe, close-hand, how phenomenon interact over time, such as how the type of hybrid governance structures and type of management control systems interact. In addition,

qualitative data does more than just measure the co-existence of different phenomena; it can provide direct evidence of relations between constructs, which can improve internal validity by supporting emergent explanations (Eisenhardt 1989).

The second reason for adopting a case method was the complexity of the phenomenon under study (Eisenhardt 1989; Patton 2002; Yin 2003). The combination of depth and defined boundaries facilitates an intense study of phenomenon in its natural context, such as how cooperation control issues materialise in inter-organisational R&D situations. This allows researchers to understand how the surrounding context influences the phenomenon under study (Dubois & Gadde 2002) and guides the interpretation of theory derived from empirical patterns (Miles & Huberman 1994). Also, because case studies can have multiple or nested layers of analysis (Yin 2003), researchers can engage in disaggregated as well as holistic analysis of phenomena (Patton 2002). This is a particularly useful feature as it enables the study of the nature and interaction of various control solutions at different organisational levels of analysis.

The third rationale for using a case method is that it aligns with the intention to develop and refine existing theory. This is because the method allows researchers to engage in an 'intensive examination' of a case, developing rich descriptions of phenomenon (Bryman 2004; Eisenhardt & Graebner 2007). The closeness to the empirical phenomenon enables case researchers to see how constructs manifest in reality and how causal relationships operate (Siggelkow 2007), and if necessary make adjustments to theoretical frames of reference in light of 'surprises' arising from empirical observation:

...we have found that the researcher, by constantly going 'back and forth' from one type of research activity to another and between empirical observations and theory, is able to expand his understanding of both theory and empirical phenomena. (Dubois & Gadde 2002, p.555)

This particular approach to case studies corresponds to what Keating (1995) describes as 'theory specification' – using cases to refine a 'sparse, underspecified theory' to make it 'amenable' to broad-scale statistical testing. In such scenarios, researchers:

...take 'theory into the field' to assess whether the theory captures the heterogeneity and complexity of the phenomenon it purports to explain prior to subjecting the theory to rigorous testing. Core concepts and relationships of the model may need to be reconceptualised, refined, elaborated, or even made more parsimonious as the researchers take the role of intervening variables, the dynamic nature of the phenomenon and the relative influence of organizational history and inertia into account. (Keating 1995, p.72)

Therefore, by using a qualitative case study design I aim to take my preliminary conceptual framework, described in Chapter 4 'into the field' to explore the degree to which it describes the nature of cooperation control problems encountered by managers in practice and also explains their managerial responses to those problems.

5.3.3. Multiple-case design

The third feature of my research strategy is the use of a multiple case design (Creswell 2007; Yin 2003). A multiple case design was chosen because of its potential, relative to a single case study, to provide more compelling evidence for theory building (Eisenhardt & Graebner 2007; Yin 2003). By studying multiple cases, researchers are able to make comparisons "that clarify whether an emergent finding is simply idiosyncratic to a single case or consistently replicated in several cases", which is argued to "create more robust theory because the propositions are more deeply grounded in varied empirical evidence" (Eisenhardt & Graebner 2007, p.27). Multiple case designs can also make it easier to understand the 'analytical generalizability' of explanations (Yin 2003), because "by comparing two or more cases, the researcher is in a better position to establish the circumstances in which a theory will or will not hold" (Bryman 2004, p.55).

Within this study I investigate two cases. Each 'case' is a distinct inter-organisational arrangement that facilitates R&D exchanges. At the centre of each case is an entity that administers these exchanges; however, the case study also includes the relevant exchange parties. These parties include the commercial or government parties who provide funds or financial resources ('R&D funders'); science-based research organisations who conduct

research activities ('R&D providers'), and other organisations that mediate the exchange (e.g. advisory bodies).¹¹²

5.3.4. Case selection

The two inter-organisational R&D arrangements selected as cases for this thesis are the Cotton Research Development Corporation (CRDC) and the Cotton Cooperative Research Centre (Cotton CRC). The CRDC and Cotton CRC constitute two inter-organisational arrangements used to facilitate R&D investment within the Australian cotton industry. These two case studies were selected because of a serendipitous opportunity to gain access to the sites¹¹³; but the case selection was also driven by a 'theoretical sampling' (Eisenhardt 1989), or 'purposive sampling' (Patton 2002) approach, as the cases represented seemingly relevant sites to study inter-organisational R&D management.

The Australian cotton industry appeared to be an appropriate setting for empirical research into the management of inter-organisational R&D for two reasons. First, there has been a long history of using various inter-organisational R&D models in the Australian cotton industry. For example, pre-dating both the CRDC and Cotton CRC, in 1972 a grower-managed research association had been established to contract researchers from public research agencies to conduct R&D projects into industry-wide issues. These researchers, who often based field trials on growers operating farms, had in turn developed long-standing ties with members of the cotton growing and processing industry. Their research was disseminated to growers through various publications and extension services funded by state agricultural agencies, complemented by a bi-annual Australian Cotton Conference (established in 1984) which is attended by researchers, growers, sales and industry representatives. The historical context of the industry, coupled with the high concentration

¹¹² Although the involvement of these parties in the inter-organisational arrangement was included within the bounds of each case, the focus of the study remained on understanding the activities and exchanges mediated by the arrangement. Therefore, while information about the party organisations was collected and formed part of the background information for both cases, priority was given to information that was relevant to understanding the operation and management of the inter-organisational arrangement. For example, the internal management of each organisation's own activities lay outside the scope of the case studies.

¹¹³ Initial contact with one of the case organisations was established during an existing project in the Australian cotton industry, led by the researcher's supervisor, which in part considered the role of R&D within the Australian cotton industry. Key industry stakeholders agreed to grant access for the purpose of this research, and data collection procedures for the original study were extended to include elements relevant to both the original project and this study.

of its members¹¹⁴ suggested that the people involved in R&D administered through both the CRDC and the Cotton CRC, would be well-positioned to comment on handling different challenges in R&D contracting.¹¹⁵

Second, the collectively funded R&D programs appeared to have been successful, which suggested that I would be able to study management structures and practices that were relatively effective and well-functioning. For example, it was widely accepted that progressive advances in cotton science (e.g. in plant breeding, soil, water, insect, weed and disease management) was a key driver to Australian cotton farmers' ability to produce the highest yielding cotton in the world (Constable 2004). In addition, there were several instances where scientific breakthroughs were perceived to have protected the viability of the industry (Hunter et al. 2012). For example, soil research in the 1980s revealed the benefit of certain approaches to soil management, preventing the large yield losses attributed to soil compaction, and improving on farm profitability and property values (Daniells et al. 1996). Breakthroughs in plant breeding and biotechnology led to the development of crop species that were high yielding, produced high quality fibre, and were also resistant to cotton's main insect predators, thus substantially reducing farmers need for pesticides (Constable 2004; Constable 2009; Constable et al. 2011; Constable, Reid & Thomson 2001). More recently, various research projects have led to substantial reductions in farmers use of water, with a 40 per cent improvement in cotton water use efficiency between 2002-2012 (Cotton Catchment Communities CRC 2012a).

Within the cotton industry setting I chose to focus on the Cotton CRC and the CRDC arrangements because of their suitability, as a pair, in addressing the central research question. Whereas in single case research, theoretical sampling may mean that cases are

¹¹⁴ An important feature of the industry is that it is highly concentrated. Although the number of cotton growing organisations has expanded to approximately 1400 operations, many of these are second and third generation family farms, as well as commercial organisations, that have existed since the 1960s. There appears to be a high level of institutional knowledge retained within the industry – many individuals involved in the two organisations subject to the case studies, have had long existing ties with the cotton industry.

¹¹⁵ This is in contrast to the control structures and MCS used in new inter-organisational arrangements, including relatively inexperienced parties. In such situations, control structures are more likely to be subject to change and adjustment as parties go through the process of learning how to manage the inter-organisational arrangement (Langfield-Smith 2008; Langfield-Smith & Smith 2003).

selected for either instrumental or intrinsic reasons (Bryman 2004; Stake 1995), in multiple cases “the choice is based less on the uniqueness of a given case, and more on the contribution to theory development within the set of cases” (Eisenhardt & Graebner 2007, p.27). The value of a ‘set of cases’ depends on the ability of each case to replicate¹¹⁶, extend, or contradict theory, by illuminating the variation in the central phenomenon of interest (Eisenhardt 1989; Eisenhardt & Graebner 2007; Yin 2003). For example, in this study one of the central concerns is to understand the implications of hybrid variation. The value of studying the CRDC and the Cotton CRC is that both are inter-organisational arrangements facilitating R&D exchanges amongst a similar set of parties, within the same industry, with a similar history and location¹¹⁷, yet they each represent a different type of hybrid arrangement.

In addition, unlike some of the more commercially oriented R&D arrangements in the cotton industry¹¹⁸, both the CRDC and the Cotton CRC were established through government legislation and have been supported by funds provided by various commonwealth and state government sources. This means that proprietary concerns were generally minimal as most of the R&D generated in the collective arrangements has been made publically and freely available, often with the express intent of generating positive knowledge spill-overs.¹¹⁹ Furthermore, rather than trying to protect against knowledge spillovers, both cases invested heavily in various forms of research extension that actively promoted the adoption and application of intellectual property. These two case studies therefore present the somewhat unique opportunity to study the risk of opportunism in

¹¹⁶ Yin argues there are two forms of this ‘replication logic’: ‘literal replications’, a case is selected for conditions where the phenomenon is likely to be found; and ‘theoretical replications’, which are contrary cases where the phenomenon is likely not to be found, for predictable reasons.

¹¹⁷ Both established in the early 1990s and were in operation at the time of the current study in 2012 (the Cotton CRC officially ceased operation on 30 June 2012 at the end of its final term). They were both located in or near Narrabri, one of the primary cotton growing regions in Australia, and home to the Australia Cotton Research Institute (ACRI), a facility that hosts approximately 80 research scientists, from various public science institutions, who specialise in cotton-related research.

¹¹⁸ For example, in 2007, the Cotton Breeding Association was established as a commercial joint venture between the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Cotton Seed Distributors that focused on plant breeding, biotechnology and the generation of transgenic crop varieties.

¹¹⁹ In fact, a substantial amount of resources are directed towards extensive initiatives, whereby various organisations distribute, communicate, raise awareness of new knowledge, and encourage uptake by industry entities.

inter-organisational R&D arrangements where appropriation concerns are likely to be minimised.¹²⁰ Furthermore, because the types of project contracts administered by both arrangements often do not aggregate towards a single technological development (e.g. the development of a new product), coordination concerns are also potentially less pressing than in previous research.¹²¹ Therefore, this case selection supports the study of cooperation control problems in settings where other control problems are likely to be less salient.

5.4. Data collection and analysis procedures

In this section I outline the considerations shaping the procedures during data collection and analysis. To provide context for these considerations – which are discussed in Sections 5.4.1 and 5.4.2 – I first provide an overview of the sequence of activities that occurred throughout the study.

The adoption of an abductive approach to theory development meant that the activities of the study iterated between collecting and analysing empirical material, and developing and refining the conceptual framework. This represented a process of ‘systematic combining’, defined by Dubois and Gadde (2002, p. 554) as a “continuous movement between an empirical world and a model world...[during which] research issues and the analytical framework are successively reoriented when they are confronted with the empirical world”. Their description of systematic combining is characterised by the intertwining of different activities, such as the development of a preliminary analytical framework, empirical fieldwork and observation, followed by further development of the conceptual framework and data collection.

Systematic combining is helpful in describing the sequence of activities that occurred in this study. Table 2 provides an overview of this sequence, showing the different stages the study went through over time, and the various activities that occurred at each stage, including the successive rounds of conceptual and empirical work. The research began with

¹²⁰ This is in contrast to prior studies of inter-organisational R&D which are set within commercial settings with high proprietary concerns (Dekker 2004; Gulati & Singh 1998; Oxley 1997; Pisano 1989; Sampson 2004); it is unsurprising that most prior studies have examined opportunism in relation to appropriation.

¹²¹ There is a level of coordination required to ensure that individual projects contribute towards broader strategic objectives which the authors take into consideration, particularly in understanding the design and operation of mechanisms such as strategic planning.

an initial familiarisation of the R&D management literature and the cotton industry setting. This was followed by a more extensive period of data collection and initial data analysis. This informed the selection and development of the TCE framing of the study, which was then followed by another smaller round of data collection and more extensive data analysis, refinement of the theoretical framework and the development of theoretical implications.

Table 2: Sequences of research activities

Period	Stage	Activities
Pre-study	Familiarisation with R&D management topic	Background reading and writing about the management control of R&D
May 2012	Initial exposure to case setting	Conduct background reading to gain familiarity about the role of R&D in cotton industry; review and preliminary coding of early interviews with members of industry; development of alternative theoretical frames of reference; interviews with industry stakeholders to familiarise with setting and gain access.
June–December 2012	Main data collection round; first round of data analysis	Interviews with members of Cotton CRC, CRDC, Cotton Australia, research providers; two field trips to Narrabri with extended observation at Australian Cotton Research Institute; observation of CRDC panel process; collection of archival documentation. First main cycle of data coding; development of preliminary case descriptions.
January–August 2013	Development of theoretical framework	Development of alternative framing for empirical material; selection of TCE as a frame of reference; background reading of TCE theory and inter-organisational management control research, and formulation of research question.
September–October 2013	Second round of data collection; second round of data analysis	Further interviews with members of CRDC during two field trips to Narrabri; collection of further archival documentation; second round of data coding; development of data matrix displays; initial cross-case analysis.
November–December 2013	Refinement of theoretical framework	Clarification of research question, review of relevant literature, identification of intended theoretical contributions.
January–June 2014	Final round of data analysis and development of theoretical implications	Final round of data analysis, focusing on patterns of control problems and control solutions both within and between case studies; write-up of case findings, and cross-case analysis; development of theoretical contributions with reference to existing literature.

Corresponding to Dubois and Gadde (2002)'s description of systematic combining, the intent of this successive iteration was to achieve a 'matching' of theory and reality, by going back and forth between the theoretical framework, data sources and analysis, with the ultimate objective of achieving a fit between theoretical explanations and empirical

observations.¹²² For example, during my initial exposure to the cotton industry and the main data collection round I sought to identify salient managerial problems that were being experienced in practice; then in the development of the theoretical framework I experimented with alternative conceptual framings, attempting to find a fit between a ‘control problem’ in the literature and the problems experienced by managers of cotton R&D. This led to the selection of TCE as a way of describing cooperation control problems, which then focused the analysis on material related to cooperation issues, and shaped later data collection rounds where I confirmed with interviewees that cooperation issues were appropriate and relevant concerns. Furthermore, in later stages of data analysis, I realised that different empirical accounts indicated the existence of different types of cooperation issues, which led to refinement of the conceptual framework, where I decomposed the cooperation control problem into three different variants.

The sequence of activities also resembles the process of ‘direction and redirection’ which occurs when researchers remain open to the possibility of altering the central research problem, intentionally seeking alternative sources of empirical material or new theoretical concepts in order to achieve a better ‘match’ between theory and reality¹²³ (Dubois & Gadde 2002). As distinct from more inductive approaches, systematic combining prioritises the role of the theoretical framework: although the framework evolves through successive refinement, it is present throughout the entire research process, to guide entry into the empirical world, to act as a point of reference or lens to view phenomenon through, and to explain emergent findings (Dubois & Gadde 2002).¹²⁴ For example, although initially I merely sought to understand the management of R&D within the cotton industry more

¹²² This also aligns to how Eisenhardt (1989, p. 541) describes the process of developing of theory using case studies as: “...a highly iterative process to compare systematically the emergent frame with the evidence from each case in order to assess how well or poorly it fits with case data. The central idea is that researchers constantly compare theory and data-iterating toward a theory which closely fits the data.”

¹²³ Dubois and Gadde (2002) describe this as the simultaneous development of the ‘evolving case’ as new empirical material is gathered and boundaries of the case are redefined, and the ‘evolving framework’ as the conceptual framing of the study is successively modified in light of new empirical and theoretical insights.

¹²⁴ This also closely aligns to Eisenhardt’s (1989) description of the use of prior literature. She suggests that prior literature be used initially to help define the research question, specify key constructs, and shape the initial research design, and then later, in a process of ‘enfolding literature’, where emergent concepts, theory, or hypotheses arising out of empirical observations are compared to extant research to test the degree to which alternative theoretical lens could explain patterns in the material, and second to identify areas where the material appeared in conflict with existing literature.

generally, once I selected the TCE framework I envisioned that the study would investigate the effect of transactional variation on governance structures and MCS, as much of the inter-organisational control research had done previously. However, as I developed case descriptions of the relevant organisations involved, and read further about hybrid organising, I realised that the empirical material offered an opportunity to studying the implications of hybrid variation, given the co-existence of two different arrangements within the same industry setting. This led to an adjustment of the level of analysis, from focusing on individual transactions to a more aggregate structure-level¹²⁵, and also clarified the research design as a two case comparative study.

5.4.1. Data collection considerations

The empirical material of the study included data collected through interviews, observation and archival documentation.¹²⁶ The following sections describe the nature of each type of data as well as the processes by which this information was gathered.

Interviews

The primary source of information was a series of interviews with individuals involved with the two inter-organisational R&D arrangements in the Australian cotton industry. This comprised of 64 interviews in total¹²⁷, ranging from 0.5 to 3 hours in length, which are listed in Table 3 and Table 4.

¹²⁵ An advantage of the early work looking at transactional variation was that I was aware of the heterogeneity of R&D exchanges administered within each arrangement. This assisted during later data analysis stages where I considered the robustness of emergent ideas in explaining patterns across different transactional scenarios.

¹²⁶ The data used for this thesis is a subset of data collection for a larger collaborative project about the Australian cotton industry, of which I was an active member. While this broader data collection informed my understanding of the context for the study, only a subset was used for the purpose of this thesis (i.e. that which was relevant to understanding the management of R&D). The information reported in this section relates to the data used in this thesis.

¹²⁷ This represents a significant proportion of the total 83 interviews conducted for the broader collaborative project. The remaining 19 interviews were excluded after review, as they did not address issues relating to R&D exchanges, nor were they with representatives of either organisation used as a case study.

Table 3: List of interviews

Month	Interviewee (Organisation – Position)	Length (hrs)
April 2012	Cotton Australia – Policy Officer	1.5
April 2012	CRDC – Senior Manager	1.5
April 2012	Research provider 1 – Private Consultant	0.75
April 2012	Commercial cotton organisation 1 – Senior Manager	1
April 2012	Extension – Consultant	1
April 2012	Extension – Consultant	1
April 2012	Extension – Consultant	0.75
April 2012	Commercial cotton organisation 1 – Senior Manager (2)	1
April 2012	Cotton Australia – Manager	1
May 2012	Cotton Australia – Manager	1.75
May 2012	Commercial cotton organisation 1 – Senior Manager	1
May 2012	Research provider 2 – Research scientist	1
June 2012	Research provider 3 – Senior research scientist	2
June 2012	Cotton Australia – Staff (3)	3
June 2012	CRDC – Program Manager	1
June 2012	Cotton CRC – Program Leader	1.5
June 2012	Cotton Australia – Policy Officer	1
June 2012	Commercial cotton organisation 3 – Senior Manager	1
June 2012	CRDC – Senior Manager	0.5
June 2012	Cotton CRC – Staff	0.75
June 2012	Cotton CRC – Senior Manager	1.5
June 2012	Cotton CRC – Senior Manager	0.5
June 2012	Cotton CRC – Program Leader	0.5
June 2012	Cotton CRC – Staff (2)	0.75
June 2012	Cotton CRC – Board Member	0.75
June 2012	Cotton CRC – Board Member	0.75
June 2012	Research provider 3 – PhD candidate	0.5
June 2012	Cotton CRC – Program Leader	0.75
June 2012	Research provider 4 – Postdoctoral Fellow	0.5
June 2012	Cotton CRC – Board Member	1.5
August 2012	Cotton Australia – Manager	1.5
Sept 2012	Cotton Australia – Manager	1.5
Sept 2012	Research provider 4 – Senior research scientist	1.5
Sept 2012	Research provider 4 – Senior research scientist	1.5
Sept 2012	Research provider 5 – Project Officer	1
Sept 2012	Research provider 5 – Senior research scientist	0.75
Sept 2012	Research provider 4 – Research scientist	0.75
Sept 2012	Research provider 4 – Project Officer	1
Sept 2012	Cotton Australia – Manager	1
Sept 2012	Research provider 4 – Research scientist	0.5
Sept 2012	Cotton CRC – Senior Manager	1

Month	Interviewee (Organisation – Position)	Length (hrs)
Sept 2012	Cotton Australia – Manager	1
Sept 2012	Research provider 5 – Research scientist	0.5
Sept 2012	Research provider 4 – Postdoctoral Fellow	0.5
Sept 2012	Research provider 4 – Senior research scientist	1
Sept 2012	Research provider 4 – Postdoctoral Fellow	0.75
Sept 2012	Research provider 5 – Senior research scientist	1
Sept 2012	CRDC – Program Manager	1.5
Sept 2012	CRDC – Senior Manager	1.5
Sept 2012	Research provider 4 – Senior research scientist	1
Sept 2012	Commercial cotton organisation 2 – Senior Manager (2)	1
Sept 2012	CRDC – Senior Manager	0.75
Sept 2012	Research provider 1 – Private consultant	0.75
Sept 2012	CRDC – Program Manager	0.5
Sept 2012	Cotton CRC – Senior Manager	0.5
Sept 2012	CRDC – Program Manager	1.5
Sept 2012	Commercial cotton organisation 4 – Senior Manager	0.5
Sept 2012	Research provider 4 – Research scientist	1.5
Sept 2012	Research provider 4 – Research scientist	1.25
Sept 2012	Research provider 4 – Administrative Manager	0.75
Nov 2012	Cotton Australia – Policy Officer	1
Nov 2012	Cotton Australia – Staff	1
Oct 2013	CRDC – Senior Manager	1
Nov 2013	CRDC – Program Manager	1
Total (64 interviews)		65.75 hrs

NOTES: Of these 64 interviews, 59 were digitally recorded and transcribed; during the remaining 5 interviews, researchers took notes. Occasionally more than one individual was interviewed at once; where multiple interviewees were present the number has been included in brackets. In order to protect the identity of interviews, generic descriptions of their position have been used.

Table 4: Number of interviews by organisation

Organisation	Interviews	Interviewees*
CRDC	10	8
Cotton CRC	12	11
Cotton Australia	11	9
Extension	3	3
Commercial cotton organisations	6	7
Research providers	22	21
Total	64	59

NOTES: * The number of interviewees represents the number of individuals who were interviewed as part of the study. This varies from the total number of interviews as occasionally more than one individual was interviewed at a time (i.e. group interview), and some individuals were interviewed multiple times. The position of interviewees by organisation has been excluded from this table to maintain the anonymity of the participants.

The selection of interviewees broadly followed a logic of ‘stratified purposeful sampling’ strategy (Patton 2002), in that I intentionally sought out individuals who represented different types of participants in the two inter-organisational arrangements. For example, I interviewed members of a range of organisations that represented different parties to the R&D exchanges facilitated through the CRDC and Cotton CRC. This included the two central entities at the core of each arrangement (i.e. the CRDC; the Cotton CRC); the industry peak body (Cotton Australia) five different research provider organisations (publically funded research agencies, universities and private consultants); four different commercial cotton organisations (cotton growing organisations or commercial firms that serviced cotton growers); and members of the broader research extension network servicing the industry.

Also, as can be seen in Table 3, the interviewees occupied a diversity of organisational positions, with varying levels of experience, responsibilities and involvement in R&D exchanges. For example, at the CRDC and Cotton CRC I spoke with individuals with different levels of managerial responsibility, ranging from administrative staff, program managers, senior managers to Board Members. It was important to interview this range of individuals as they were each familiar with different control structures and mechanisms operating at different organisational levels. Furthermore, I was able to develop a more holistic understanding about how the control approaches were perceived and rationalised, which did not rely on any single respondent.¹²⁸

The style of how the interviews were conducted varied at different stages of the study. The initial interviews were conducted in an open-ended manner (Silverman 2006), in order to gather broader contextual information about the industry and the role of R&D within it, and to allow interviewees to raise salient problems they faced, without necessarily being led by

¹²⁸ I interviewed a similarly broad range of individuals at the research provider organisations, including PhD students and postdoctoral fellows who were relatively new to R&D in the cotton industry, scientists with varying degrees of experience in cotton R&D, as well as senior research scientists and administrators who had more managerial responsibilities for ensuring funding for themselves and other individuals. The diversity of researchers interviewed was reflected in their varying accounts of their perceptions and experiences of interacting with the two inter-organisational arrangements. This provided a broader understanding of how the management control of the CRDC and Cotton CRC operated in practice, and later gave context to understanding why different sets of R&D exchanges were more problematic than others.

the interviewer. These interviews were also important for establishing rapport and support with industry stakeholders; this often required the adoption of a more conversational style (Patton 2002). In the main data collection round, most of the interviews were conducted in a more semi-structured manner (Silverman 2006). They remained open-ended and flexible, in order to focus on interviewees' particular experiences and expertise; however, the topics discussed were structured by a preliminary interview guide or protocol based on the study's research questions (Creswell 2007; Patton 2002; Yin 2003). For example, questions were asked about the interviewees' personal background and position; the role of the CRDC and Cotton CRC in the industry; the research management practices; and their perceptions on what influenced the effectiveness of research management. As many of the interviewees had involvement in both the CRDC and the Cotton CRC, a set of probing questions were used to gather comparative information about the perceived differences and similarities between the two arrangements. The interviews conducted towards the end of the main data collection phase and in the subsequent follow-up stages became much more targeted and focused on specific topics. The intent of these interviews were to clarify particular issues raised in earlier discussions (e.g. distinguishing between annual and strategic planning); as well as to test the appropriateness of interpretations arising from the data analysis (e.g. the relevance of cooperation issues in shaping management practices; the identification of particular sets of 'problematic' transactions).

The majority of interviews were conducted with at least two researchers present¹²⁹, allowing for one researcher to ask questions while the other listened, developed follow-up questions, and took notes. After each interview the researchers de-briefed by discussing their initial impressions of what had been discussed and by taking additional notes. Almost all interviews were digitally recorded and transcribed; in the unrecorded interviews, the

¹²⁹ I was present at 45 of the 64 interviews used in this thesis. The remaining 19 interviews were conducted by other members of the team as part of the broader collaborative project. These interviews were conducted as part of the initial phases of background data collection (in April – May 2012), whereby the team gained familiarity with nature of the industry and its members. These have been included in this thesis because within these early discussions respondents raised the issue of R&D and described its significance to the Australian cotton industry. While it is not ideal that I was not present at these early interviews, as I potentially missed opportunities to 'drive' the conversation to explore emergent insights, I was able to return to these issues in subsequent follow-up interviews that I conducted with key interviewees from this early data collection period.

interviewers took extensive notes. The transcriptions of the recorded interviews were then checked for accuracy, by listening to the original recordings and referring to interview notes.

Observation

The second source of information was observational data collected through a series of different site visits and field trips, which I experienced primarily as a non-participant observer (Creswell 2007). This field work, listed in Table 5 below, provided an opportunity to observe the physical activities related to the conduct, contracting and use of R&D within the industry; how certain management processes occurred; and more generally how different organisational members behaved and interacted with one another.

Several of these site visits coincided with the conduct of interviews at the work places of interviewees. This provided an opportunity to see the workplace as well as observe incidental ‘around the corridor’ interactions with other members of the organisations. For example, I made numerous visits to the headquarters of the CRDC in Narrabri, where I would spend time ‘hanging about’ (Miles & Hubermann 1994), reviewing and photocopying archival documents in the CRDC library, and chatting informally with the CRDC managerial staff. I also spent several weeks at the Australian Cotton Research Institute (ACRI) at Myall Vale. This facility housed approximately 80 research staff from different research providers and the headquarters of the Cotton CRC. During these extended visits, I tried to gain a sense of what it was like to do research in the cotton industry, by catching the staff bus to the facility, working in an unoccupied office, joining staff at the communal breaks (e.g. morning and afternoon ‘smoko’ and lunch), and attending ad-hoc staff meetings.

Table 5: List of site visits and field trips

Period	Site(s)	Location	Duration
Jun-12	University research providers	Sydney	1.0
Jun-12	CRDC; Cotton CRC; ACRI	Narrabri	2.0
Aug-12	<i>Australian Cotton Conference</i>	Gold Coast	3.0
Aug-12	Cotton Australia	Sydney	0.5
Sep-12	Cotton Australia	Sydney	0.5
Sep-12	ACRI; Cotton CRC; CRDC; other cotton organisations in Narrabri region	Narrabri	11.0
Nov-12	Cotton Australia	Sydney	0.5

Nov-12	Cotton Australia Panel review meetings; Cotton Australia AGM	Sydney	2.0
Sep-13	<i>Australian Cotton Research Conference</i>	Narrabri	3.0
Oct-13	CRDC; farming operations in Narrabri and Moree region; ACRI	Narrabri	5.0
Mar-14	Cotton Australia	Sydney	0.5
Total (days)			29.0

I also attended two different conferences, which provided opportunities to see how members of different types of organisations interacted with one another. The first was the Australian Cotton Conference, which involved 1400 delegates from all different types of industry organisations (e.g. cotton growers and producers; trade, equipment and supplier representatives; cotton marketing and shipping organisations; researchers; and non-commercial industry bodies). The second conference – the Australian Cotton Research Conference – was focused solely on discussing science-based issues, and was attended primarily by researchers and managers of the CRDC.

In addition, I was able to directly observe the practice of how funders and managers evaluate and select R&D projects for investment by attending meetings where prospective research proposals were evaluated and ranked by farmer representative panels. The meetings also coincided with the annual general meeting of Cotton Australia, where several facilitated discussions and presentations were given about the needs for R&D in the industry. During these two days it was also possible to engage in more informal discussions with various farmers about their perceptions of R&D and the R&D contracting processes.

The observational data collected during each of these various field experiences was recorded through extensive note taking, which occurred during and after each day of field work. In these notes I distinguished between descriptive information about the activities, interactions and locations I observed, interpretative information about my perceptions of what I had encountered, and reflective information about the ongoing research process (Creswell 2007). I also engaged in a process of de-briefing through regular discussions with my supervisor as well as other members of the larger collaborative team.

Archival documentation

Interview and observational data was complemented through the collection of a substantial amount of archival documentation (Patton 2002). The types of archival documentation

collected are listed in Table 6 below. Most of this data was collected online; paper-based documentation was typically copied and scanned¹³⁰.

Table 6: List of archival documentation collected

Scope	Type of archival documentation
Cotton CRC	Annual reports (1993–2012)
Cotton CRC	Public documents about Commonwealth CRC program
Cotton CRC	List of current and completed projects (2005–2012)
Cotton CRC	Internal management documents (Board Book; Project management procedures manual; project evaluation template; Red Amber Green reports; Strategic Plans)
Cotton CRC	CRC Participants Agreement, CRC Commonwealth Agreement, CRC Affiliate Agreement
Cotton CRC	CRC Application material
Cotton CRC	Examples of calls for research proposals
Cotton CRC	Conference documentation and presentations
Cotton CRC	CRC Exit Book
Cotton CRC	External reviews of Cotton CRC economic impact
Cotton CRC	Examples of final project reports
CRDC	Annual reports (1990–2013)
CRDC	Five year strategic plans (1991–2018)
CRDC	Annual operating plans (1991–2013)
CRDC	CRDC Researchers Handbook
CRDC	Project evaluation templates
CRDC	Deed Agreement
CRDC	Productivity Commission Review of RDC Structures (review report and submission documents)
Other	Cotton Industry Research Development & Extension Strategy
Other	Cotton Industry Vision 2029
Other	Australian Cotton Growers Research Association Board Book (1974–2002)
Other	Australian Cotton Conference Proceedings (1984–2012)
Other	Australian Cotton Grower Yearbook
Other	Timeline of history of Australian Cotton Research Institute
Other	Australian Cotton Crop Statistics (ABARES)
Other	Cotton Australia Annual Reports (1996–2013)

The role of different types of archival documentation varied. A large portion was used peripherally to develop an understanding of the broader context of the industry, including the role and relation between different organisations, the historical contribution of R&D, and the intended strategies for R&D. Other documents were more central to the objects of inquiry. For example, the Cotton CRC and CRDC annual reports, strategic plans and annual operating plans provided qualitative and quantitative information about the nature of R&D investments facilitated within the two case studies. As this information was structured

¹³⁰ For some documents it was not possible to obtain copies. In these cases I reviewed the original document and took more general notes.

in a relatively consistent format it was possible to generate time series information about the number and duration of project contracts, the research providers, the research funders, and the value of R&D investments over time. Finally, particular documents, such as the annual reports and plans, internal management documents, and statutory governance documents, were directly relevant for understanding the design of the control structures and mechanisms of both cases. These documents described the design and operation of management control structures, and in some cases, represented physical artefacts (Yin 2003) of the control mechanisms themselves.

5.4.2. Data analysis considerations

The analysis of the data collected followed an abductive approach involving the systematic combination of case material and developing conceptual framework. During this process there were four salient considerations, including the choice and development of coding and analysis procedures; the sequencing of single case and cross case analyses; discerning explanatory patterns about control problems and solutions; and developing theoretical implications from the empirical results.

Coding and preliminary analysis procedures

One of the most significant data analysis considerations was the development and application of coding methods as a way to structure, categorise and access the empirical material. All the empirical material (interview transcripts and notes, observational notes, and archival documents) was stored centrally using Computer Assisted Qualitative Data Analysis Software (CAQDAS)¹³¹; however, the coding effort focused primarily on the interview transcript data. The coding occurred through three different cycles, involving a variety of coding methods (Saldaña 2013). A summary of the different coding techniques used is provided in Table 7.

¹³¹ Specifically I used Nvivo (v.10) software.

Table 7: Coding cycles and techniques

Coding cycle	Coding method	Description	Examples	Rationale
First cycle (preliminary coding)	Holistic coding	Coding of large 'chunks' of data	PERSONAL BACKGROUND USE OF R&D	Used to gain a simple overview of the main content of prior interviews
	Descriptive coding	Summarises the basis topic of each segment of data	R&D SUCCESS R&D STRATEGY CRC CLOSURE GROWER-SCIENTIST RELATIONS	Used as basic categorisation of the topics raised in prior interviews about R&D
Second cycle	Attribute coding	Logs essential information about data source	PARTICIPANT DATE POSITION ORG NAME ORG TYPE	Used mainly as data management technique. Later allowed the filtering of interview data by interviewee/organisation
	Provisional coding	Apply a list of predetermined codes based on conceptual framework and research questions, which can be adapted, changed, modified or refined	R&D CHARACTERISTICS UNCERTAINTY ORG REPOSE PLANNING R&D OUTCOMES	Used to categorise data according to emergent conceptual framework. Provided focus on R&D management topic (useful for interviews that were more tangential)
	Magnitude coding 'Scope coding'	Supplementary coding style to indicate intensity, frequency, direction or evaluation of comments. 'Scope' codes categorise the scope of participants comments	WHOLE INDUSTRY CRDC – GENERAL CRC – SOCIAL SCIENCE CRC – SPECIFIC PROJECT	Used to categorise interviewees' comments by the organisation, as well as the level that they were referring to. Formed primary dimension of many data matrix tables
	In vivo coding	Codes based on interviewee language, that capture emergent themes or categories, or ideas	LIMITED LIFE GLUE PUBLIC GOOD	Used to balance the use of provisional coding, to allow for the inclusion of new themes raised by interviewees

Coding cycle	Coding method	Description	Examples	Rationale
Third cycle	Sub coding (axial coding trees)	A system of parent and child codes, used to add detail, depth, specificity to categories	PROJECT SET-UP: CALL PROJECT SET-UP: PROPOSAL PROJECT SET-UP: EVALUATION PROJECT SET-UP: FEEDBACK PROJECT SET-UP: CONTRACT	Used when initial code was too general, or if various qualities emerge in category. Enables multi-level analysis
	Versus coding	Identify dichotomous or binary terms	CRC vs. CRDC SOCIAL SCIENCE vs. PRODUCTION	Used to capture comparative statements made by interviewees. Coded data used to verify patterns derived from data analysis

During the first cycle, I coded existing interviews that pre-dated the study¹³² to gain familiarity with the various issues associated with R&D management. This cycle involved a combination of ‘holistic coding’ – coding large lumps or ‘chunks’ of data, and ‘descriptive coding’ – summarising the basis topic of each segment of data (Saldaña 2013). This preliminary analysis revealed general perceptions amongst various industry stakeholders that R&D was a significant factor influencing the productivity of the Australian cotton industry, and that this had been facilitated through more collaborative arrangements. This led to the refinement of the study’s research aims to investigate the inter-organisational management of R&D.

The second cycle of coding began approximately halfway through the main data collection period. The intent of this cycle was to begin classifying and sorting the empirical material, so as to better understand how emerging theoretical dimensions compared to the practice of R&D management in the two cases. This involved the design and application of more sophisticated coding system, involving a combination of ‘attribute’, ‘provisional’, ‘in vivo’ and ‘magnitude’ codes. ‘Attribute coding’, which captures basic descriptive information about a data source (Saldaña 2013), was used primarily as a data management tool;

¹³² These comprised of 10 interviewees that were conducted by other members of the larger collaborative project about the Australian cotton industry, before I joined the project team.

however, later these codes were also used as filters to sort comments from different types of interviewees (e.g. by organisational affiliation).

The main content of the transcripts was captured through ‘provisional coding’, in which I applied a predetermined list of codes developed from the main research questions and basic theoretical categories (e.g. ‘R&D characteristics’, ‘R&D outcomes’), which were modified, refined, revised and extended as the coding progressed. Although this style of coding is appropriate when the research is positioned to build upon and extend prior literature and theory, it can be used too restrictively, leading the researcher to force the data into pre-set categories or overlook significant themes (Saldaña 2013). To address this potential danger I used a combination of memo-writing, to reflect on the adequacy and difficulties in using particular codes (Miles & Hubermann 1994); periodic reviews of the entire coding list; and ‘in vivo’ coding, to capture emergent ideas not represented by existing categories. Finally, I developed a particular style of ‘magnitude coding’ – which is a supplementary coding system to denote certain qualities of comments (Saldaña 2013) – referring to the scope or domain about which the interviewee was talking about. Scope and provisional coding methods enabled me to run compound queries that collected data by the domain of the comment (e.g. the CRC or SOCIAL SCIENCE), and then by its descriptive category and by the domain of comment; using this classification was then able to develop case descriptions for the CRC and CRDC (Yin 2003). In writing these case descriptions I incorporated the information gathered from the observational data and archival documentation.

The final cycle of coding¹³³ followed the selection of the TCE theory as the main conceptual lens, and the choice to focus on the management of cooperation control problems. Therefore, the aim of this cycle was to revise the way the data had been coded in previous rounds, and adjust the coding list to achieve a better alignment between the categories of empirical material and the emerging conceptual framework. In addition, I integrated the in vivo codes from the second cycle into the main coding list and used sub-codes (Saldaña 2013) and axial coding trees (Miles & Hubermann 1994) to group, redefine and classify the provisional and scope codes, creating multi-level categories of codes. This

¹³³ The final cycle of coding began with the ‘second round coding’ listed in Table 2; however, it continued through until the final stage of data analysis.

process led to a ‘sharpening’ of theoretical constructs (Eisenhardt 1989) by assessing the extent of empirical support for different conceptualisations. For example, during early analysis procedures I had attempted to overlay different constructs of MCS from the inter-organisational management control research (e.g. market-based, trust-based, bureaucracy-based patterns; social, process and outcome controls). As none of these frameworks seemed to ‘fit’ the data appropriately, I reverted to using more descriptive or in vivo categories to describe the mechanisms. In the final coding cycle, I experimented with various sub-code classifications to develop a coding framework which captured all the mechanisms and structures in the two arrangements as well as minimised overlaps between codes. The other type of coding method used in this cycle was the introduction of several ‘versus’ codes (Saldaña 2013) into the magnitude scope coding list. These codes aimed to capture comparative statements made by interviewees, such as when they compared different R&D transactions (‘SOCIAL SCIENCE VS PRODUCTION’) or the two cases (CRC VS CRDC).

The outcome of the final coding cycle was two sets of multi-level axial coding lists: one related to the conceptual categories (an example branch was ‘control solutions: governance structure: formalisation: associational contract’), and one related to their scope (e.g. ‘CRC: SOCIAL SCIENCE’). Using these two coding lists as the main dimensions, I then used matrix coding queries to construct of a variety of data matrix displays (Miles & Hubermann 1994). For example, I use tables to sort data about all the types of control solutions by case organisation (CRC and CRDC). Alternatively, I compared comments about different control problems by case, as well as by the types of R&D within each (CRC SOCIAL SCIENCE and CRC PRODUCTION).

Working from single cases to cross-case analysis

The second major consideration in the data analysis was to sequence the examination of the empirical material to ensure a clear demarcation between single and cross-case analyses (Miles & Hubermann 1994). Although data was collected and coded about the two arrangements simultaneously, during the initial stages of data analysis, each was treated as a single, separate case. In both the first and second rounds of data analysis I worked only with one case at a time, aiming to develop standalone descriptions of the mechanisms,

structures, and operation of each case arrangement. The intention of treating each as a single case study was to “become intimately familiar with each case as a standalone entity...to allow the unique patterns of each case to emerge before...push[ing] to generalize patterns across cases” (Eisenhardt 1989, p.540).

To develop case descriptions, I first reviewed the relevant coded interview data for each case.¹³⁴ I re-read the coded data for each provisional code and wrote short summaries about the nature of the R&D transactions, the historical background, and the nature of each management mechanism. To cross-check the validity of interviewee’s statements, and to provide further depth in the case descriptions (Miles & Huberman 1994; Patton 2002; Yin 2003), I also combined coded interview data with the broader body of archival and observation data. For example, to develop my description of the CRDC’s project selection processes I combined coded data about interviewee’s perception of the CRDC panel process with the observation notes I made during the panel sessions, and the stages of the project proposal process listed within the CRDC Researcher’s handbook.

I also used the archival and observational data to develop an understanding of the broader operating context of each arrangement. For example, based on the annual reports I was able to compile descriptive statistics about the number of projects and level of funding of each arrangement; the contracted R&D provider organisations; the evolution of the strategic objectives; and the structure and composition of portfolio of projects within each research program. Similarly, in the early case descriptions¹³⁵, I included reference to the physical and social environments I observed when visiting the headquarters of the CRDC, Cotton CRC and Cotton Australia, the ACRI, cotton grower properties, conferences, and the locations of other research providers. These data sources were important to the study as they enabled access to the ‘taken-for-granted’ background information that interviewees did not systematically discuss. Also, it allowed for the development of a foundation understanding about the nature of the specific operating context, which enabled more

¹³⁴ I used my ‘scope codes’ to filter the interview data so that I could review only the coded data that related to the relevant case study. This enabled me to focus on one case at a time.

¹³⁵ Due to their length, much of these early case descriptions have not been included in the final thesis document.

detailed interpretation of the nuances of interviewees' evaluative comments about the problems in managing R&D.

Once I had developed case descriptions and analysed the patterns that existed between control problems and solutions at a single case level, I engaged in cross-case analysis using a process of 'forced comparison' (Eisenhardt 1989) to compare the two cases, by various categories, listing similarities and then differences. Initially comparisons were simply descriptive in nature, for example, seeking to compare the *types* of management control systems in each of the arrangement, or the *nature* of the structural features of the hybrid governance structure. Comparisons then became more explanatory, seeking differences and similarities in *patterns of relations*, for example, between the reliance on MCS and hybrid structures at different stages of contracting. Emergent cross-case patterns were then verified through the reference to 'versus coded' material that recalled specific excerpts where interviewees had made comparative statements between the Cotton CRC and CRDC.

Discerning patterns of control problems and solutions

The third consideration of the data analysis stage was how to discern relations between control problems and solutions from the empirical material. The overarching approach taken was pattern-matching (Eisenhardt 1989; Miles & Huberman 1994; Patton 2002; Saldaña 2013), both within and between the two cases. However, this process was challenging because while the interviewee and supplementary material provided substantial direct evidence about the nature and variation of 'control solutions' (i.e. the existence of managerial practices and structures), it was more difficult to assemble standalone material substantiating the existence of 'control problems'. This was because it appeared that 'control problems' rarely exist as exogenous, discrete, readily observed phenomenon in organisational settings; rather they manifest in the rationale for using particular control structures or mechanisms¹³⁶, which may or may not be explicit. Thus, I developed a particular analytic approach by working backwards from the structures and mechanisms, considering how they constituted 'control solutions' that reduced the occurrence or severity

¹³⁶ This seems akin to a 'garbage-can model' of organisational choice, made up of both problems in wait of solutions, and solutions in wait of a problems (Cohen, March & Olsen 1972).

of particular types of cooperation control problems. In this section, I elaborate on the different components of this process.

The first step was to review the first-hand accounts provided by the CRC and CRDC managers. In these accounts, managers provided some explicit explanations of how particular practices or structures dealt with a problem identified by the manager, such as the use of pre-investment screening and evaluation practices to reduce the occurrence of misrepresentation by providers in the contract set-up. More often their accounts provided indirect evidence of the control solutions capacity. For example, they discussed the rationale, logic or intention in using certain mechanisms or practices; why structures or practices have been changed; or the perceived effectiveness of the control solutions. Also, the interviewees familiar with both structures made comparative statements that highlighted the relative benefits or drawbacks of how R&D transactions were administered in one arrangement compared to the other.

These accounts, however, only provided a partial depiction of the dynamic between control problems and solutions. This was because no single manager appeared to have a complete understanding of all the different mechanisms and structures, and had different awareness of cooperation hazards. For example, interviewees would often raise and identify a range of problematic issues, which appeared to be symptomatic of cooperation problems, yet provided little indication of what they thought were the underlying causes. Also, their accounts appeared influenced by a cognitive bias towards salient problems; managers tended to speak more about inefficiencies or instances of misalignment than benign situations where the current systems kept operations 'under control'. Furthermore, they appeared more likely to highlight control solutions where they had a greater sense of agency, such as when MCS were introduced or changed, or routine processes called for managers to exercise discretion. This also meant that managers were more likely to provide evidence of the control capacity of MCS for specific problems rather than for some of the broader structural features, which were often treated as 'taken for granted' elements of the operating context.

Thus, to develop more complete explanations of the control capacity of the hybrid structures and MCS I supplemented my examination of managerial accounts with a theorisation process akin to what Weick (1989, p. 516) describes as ‘disciplined imagination’:

...where the ‘discipline’ in theorizing comes from consistent application of selection criteria to trial-and-error thinking and the ‘imagination’ in theorizing comes from deliberate diversity introduced into the problem statements, thought trials, and selection criteria that comprise that thinking.

I started with the problem statement of how are cooperation control problems addressed by combinations of hybrid structure and embedded MCS. Then, I conducted a series of thought trials, in which I assumed the existence of the three potential cooperation control problems¹³⁷ and considered how the hybrid structural dimensions and embedded MCS contributed to the minimisation of the problem.¹³⁸ To ensure the independence of these thought trials I relied on a strong classification system, where I worked systematically through each combination of the three control problems, the three hybrid structure dimensions, and four embedded MCS categories, for each of the two cases.

To develop the resulting explanations, I selected the control solution/control problem combinations on the basis of plausibility and robustness. Plausibility was judged based on my understanding of the operation of the structures and MCS within each hybrid arrangements; whereas robustness was assessed in terms of the degree to which explanations applied coherently and consistently to observable empirical patterns both

¹³⁷ As part of this process my preliminary assumption was that both entities face similar potential for cooperation hazards, which differs from the approach used often in previous management accounting research which tends to evaluate and measure for variation in cooperation hazards, proxied by transaction characteristics measured by quantitative cross-sectional data. Because of the similarity in the two arrangements’ operating context, simplifying this assumption did not appear unreasonable; and as the analysis progressed, it became possible to retrospectively infer a more nuanced view of the underlying control problem potential of both cases, which will be discussed further in Chapter 10.

¹³⁸ This is not to imply that I assumed that control solutions were perfectly optimal, or that all control problems had been addressed.

within and between the cases (Eisenhardt 1989).¹³⁹ Furthermore, I was mindful of the danger of developing ‘hagiographic’ accounts of the cases; this was addressed by looking for ‘negative cases’ (Patton 2002). For example, although both arrangements were considered to be highly successful overall, respondents did describe certain persistent problems in managing R&D projects. Because of the number of exchanges handled by each arrangement, I treated different sets of R&D exchanges as embedded units of analysis (Yin 2003), and studied instances when control solutions were perceived as less effective, or when particular transactions were more problematic, or when control solutions had been adjusted. Based on the analysis of negative embedded cases, I refined theoretical explanations so that they were consistent with both unproblematic and dysfunctional situations.

Finally, in order to minimise the risk of confirmation bias – in selecting and prioritising information that supported the explanations to the exclusion of the counter-factual – the preliminary results were discussed and refined through discussions with colleagues familiar with the cases and internal managers in subsequent rounds of interviews (Patton 2002; Yin 2003).

Developing theoretical implications

The final consideration in the data analysis stage was how to develop theoretical implications from the empirical results. This was accomplished by attempting to develop a deeper, yet more general understanding of the key relationships within my conceptual model. These relationships were the inter-dependencies between control solutions, specifically between hybrid structure and embedded MCS; and the relation between control problems and control solutions.

To develop conceptual implications about both these sets of relations I first went through a process of ‘enfolding’ my empirical results with the extant literature (Eisenhardt 1989). That is, I compared my findings with prior explanations of these two sets of relations found

¹³⁹ Eisenhardt (1989) suggests that one useful approach to cross-case pattern matching is to look for explanations that correspond to both observable within-group similarities and observable inter-group differences.

in previous studies to identify where my results confirmed or supported existing theory and, perhaps more significantly, where my results appeared to either conflict or extend prior work.

This generated a series of follow-on questions, for which I attempted to develop plausible theoretical explanations. For example, starting with the question of how are different control solutions inter-dependent, I then considered how different inter-dependencies may co-exist within the same inter-firm arrangement, and how alternative types of inter-dependencies could be differentiated. Likewise when considering the broader question of how do control problems and solutions relate, I also considered why control problems determine control solution choices, how control problems shape inter-dependent control solutions and when would control problems and solutions not relate. Similar to the process of ‘disciplined imagination’ (Weick 1989) described above, to answer these questions I developed plausible explanations through a process of trial and error, working back and forth between empirics and explanation, to ensure consistency between patterns in empirical material, conceptual assumptions and resulting theoretical explanation.

5.5. Chapter summary

In order to understand how hybrid governance structures and MCS address cooperation control problems in external R&D exchanges, I will analyse empirical material gathered through a qualitative case study of two inter-organisational arrangements in the Australian cotton industry. In this chapter I have accounted for the choices concerning the design and execution of this empirical approach. In Section 5.2 I detail the realist ontological and epistemological assumptions of the study, which appear appropriate given the aim to develop causal explanations using theory from existing MCS and TCE literature. This is followed by an outline of the overall research strategy in Section 5.3, including the selection of an abductive approach to theory development, a qualitative case study method; a multi-case design and the selection of the Cotton CRC and CRDC cases. Each of these choices were rationalised in terms of their suitability in refining theory from TCE and MCS literatures and enabling the development of more specified explanations about how cooperation control problems are addressed based on empirical observations from the two cases. Finally, in Section 5.4 I detailed the sequence of stages of the study’s

implementation; consistent with the ‘systematic combining’ that occurs within abductive studies, this was characterised by several iterative rounds of data collection, analysis and conceptual development.

In the following chapters I present the results of the data analysis procedures described in Section 5.4.2. These are ordered to abstract progressively from the empirical material to the broader theoretical implications of the study. In Chapters 6 and 7, I present the case descriptions of the CRDC and Cotton CRC. These case descriptions introduce empirical material describing each case’s operating context, as well as the design and operation of the management mechanisms used to manage their R&D portfolios. In Chapter 8, I present the results of the cross-case analysis of the two cases based on the categories within the preliminary conceptual framework. In Chapter 9 I present the results of the analysis of the patterns of relations between the three control problems and hybrid structure and embedded MCS solutions. Finally, in Chapter 10, I discuss the broader theoretical implications of the study by explicating how the results extend our understanding of the relation between control solutions, and the relation between control problems and control solutions.

Chapter 6: The Cotton Research and Development Corporation (CRDC)

6.1. Introduction

The aim of this chapter is to present empirical material describing the nature of R&D contracting and management within the Cotton Research and Development Corporation (CRDC). This case description is structured into four main sections. First, in Section 6.2 I present the background and overview of the CRDC arrangement. This describes the historical origins of the CRDC and the legislative requirements that shape the role of the CRDC entity; the CRDC's funding flows; and CRDC's relation to its funding organisations. Then, in Section 6.3 I outline the strategic R&D planning process, which shapes the long-term patterns of R&D investment over 5-year cycles. This is followed by a description of the annual operational planning processes in Section 6.4, which comprises of a series of project management processes used to develop and select projects for investment. Finally in Section 6.5 I describe how the CRDC monitors and manages R&D projects, both at an individual project-level as well as at the level of the entire portfolio.

6.2. Background and overview

The CRDC is one of 15 Rural Development Corporations (RDCs)¹⁴⁰ established in 1989 under Commonwealth statute to invest in research on behalf of Australian agricultural producers and the Australian Government. It replaced an existing arrangement that began almost two decades earlier in 1972 with the formation of the Australian Cotton Growers Research Association (ACGRA). The original arrangement began as a grower-run committee that directed the spending of voluntary levy contributions from four grower industry organisations who recognised the need for science to improve cotton production in

¹⁴⁰ The remaining 14 RDCs are the: Australian Egg Corporation Ltd; Australian Pork Ltd; Australian Wool Innovation Pty Ltd; Dairy Australia Ltd; Fisheries Research & Development Corporation; Forrest & Wood Products Australia; Grains Research & Development Corporation; Rural Industries Research and Development Corporation; Sugar Research and Development Corporation; Grape and Wine Research and Development Corporation; Australian Livestock Export Corporation Ltd; Horticulture Australia Ltd; Meat & Livestock Australia Ltd; Australian Meat Processor Corporation Ltd.

areas such as plant breeding, fertiliser, irrigation and pest management. The pool of R&D investment funds grew as the levy value increased and membership expanded. In 1981, the Australian Government began matching the grower levy through the creation of the Cotton Research Council. In 1989 the Cotton Research Council was replaced by the CRDC which was established under the *Primary Industries and Energy Research and Development Act 1989 (Cth)* (PIERD Act).

The PIERD Act formalises several aspects of the overall design of the CRDC arrangement and establishes the powers and functions of the CRDC entity, directors and managerial staff. Most of these functions are oriented around two planning processes, including the long-term strategic investment plan, the annual operational plan, as well as monitoring and reporting activities.

6.2.1. CRDC funding streams

The PIERD Act also determines the CRDC revenue, which are derived primarily¹⁴¹ from the compulsory industry levy collected from all cotton growers at the point of ginning¹⁴² and the matched contribution by the Australian Government. The industry levy is based on actual cotton production, which is highly variable, depending on the availability of water within catchment areas such as the Murray Darling Basin Area. Because the government levy matches the grower contributions, the bulk of the CRDC revenue stream is seasonal, tied closely to patterns of rainfall and cotton production (see

Figure 2):

Our business follows the fortune of the industry, it really does. (CRDC Senior Manager)

There is some smoothing in revenue that occurs because of the way the government contribution is determined¹⁴³; however, extended or prolonged reductions in production

¹⁴¹ Other sources of income include a share of royalties from the sale of seed varieties (developed using CRDC funds), interest on investments, and other external grant revenue and project refunds.

¹⁴² Ginning occurs after the cotton has been picked, when the cotton lint is separated from the seed. As ginning occurs from March to September of each calendar year, the levy revenue in any financial year is actually drawn from two consecutive cotton crops.

¹⁴³ The Australian Government contribution is calculated as 0.5% of the three-year average of the gross value of Australian cotton production.

place significant resource constraints on CRDC revenue. For example, during the drought that lasted from 2004–2008, CRDC revenue halved.

We were only a year or a bit more away from being in a very difficult financial position ourselves. It was horrible. If we hadn't had the Cotton CRC throughout, it would have been worse. So that's one of the issues going forward, is the volatility in the industry production, provides for significant risk to the industry R&D. (CRDC Senior Manager)

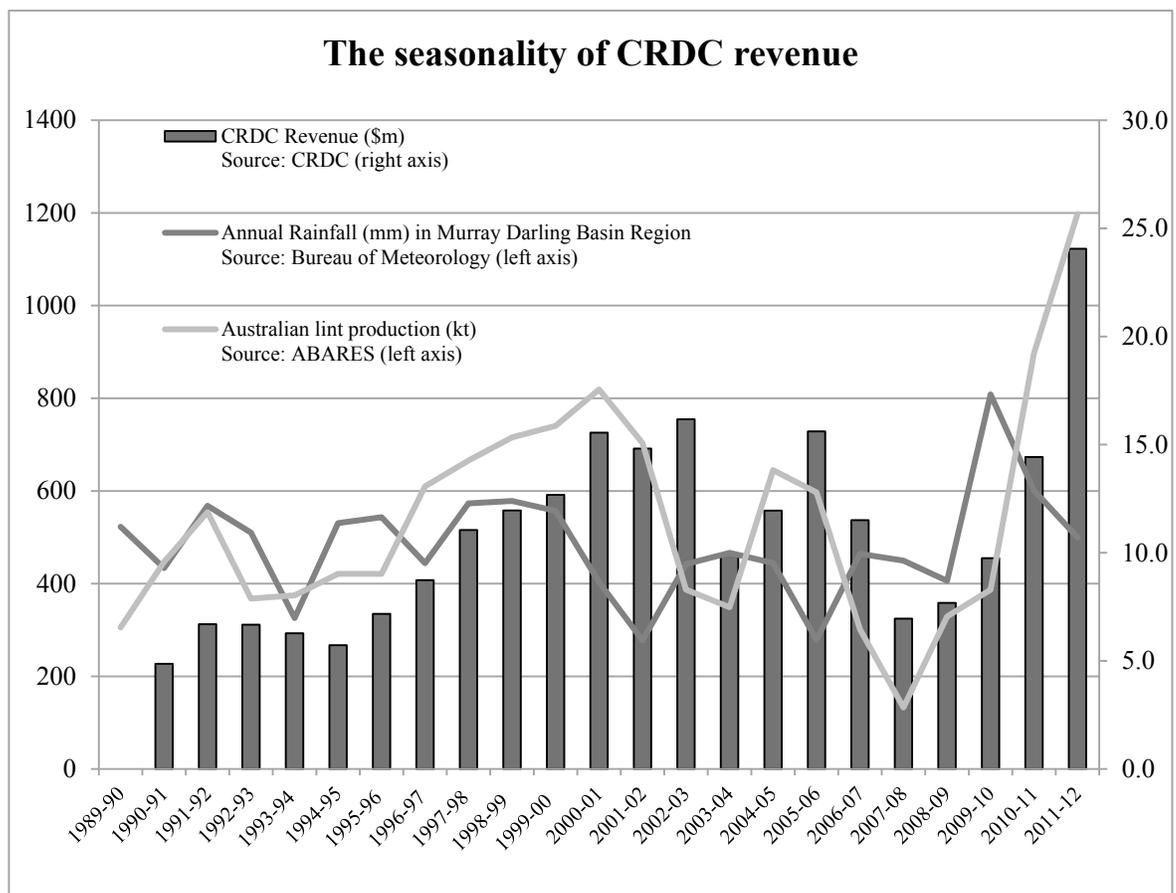


Figure 2: Variability in rainfall, cotton production and CRDC revenue

The only mechanism used to manage the variability in revenue is the balance of cash reserves; however, these were not sufficient to maintain the CRDC’s level of expenditure:

We have the ability to manage fluctuation in revenue with reserves. But typically we carry one to two years spend in reserves. But when you go into that sort of prolonged drought, five years, we had to reduce expenditure by 25 per cent, not only external funding but our own costs. Then your ability to do anything really radical, it's all about what's core – if it

was a cattle herd, where are the key breeders and the key genetics, we've got to keep that and the pain is that you lose any ability to do succession planning. (CRDC Senior Manager)

As this quote describes, one consequence of the fluctuations in resource availability is that it constricts investment decisions and reduces the CRDC's capacity to fund its entire pool of R&D providers.

6.2.2. The relation to funders

The PIERD Act also defines the two primary constituents of the CRDC: the Australian Government, as represented through the relevant Federal Minister of Agriculture¹⁴⁴, and the Australian cotton growers, as represented by the 'peak industry body' (initially this was the ACGRA; after their merger in 2008 it became Cotton Australia¹⁴⁵). These representative bodies are assigned responsibilities for presiding over the conduct of the CRDC, reviewing strategic investment plans, and holding the CRDC accountable for its investments and management of research activities. Cotton Australia is also responsible for providing industry direction in the development of the CRDC's plans. This occurs through grower representative 'panels' comprised of individuals who have been actively involved in the production or processing of cotton.¹⁴⁶

6.3. Long-term strategic R&D investment planning

The allocation of funds towards R&D is determined by consecutive long-term strategic investment planning cycles. Every 5 years the CRDC develops a strategic plan that sets the

¹⁴⁴ The specific name of the agricultural portfolio has changed over time.

¹⁴⁵ In 1972 two organisations were established within the Australian cotton industry: the Australia Cotton Foundation – which was intended to act as an advocacy body which handled the promotion and public perception of the industry; and ACGRA – which was a grower-led body dealing with research issues. For 36 years the two bodies served the industry performing these roles separately (promotion and R&D participation), during which time the Australia Cotton Foundation was rebranded as Cotton Australia (in 1997). However, both organisations faced significant financial strain during the most recent drought; this prompted a merger of the two organisations in 2008.

¹⁴⁶ The panel structures reflect the CRDC R&D portfolio structure, with one panel generally for each of the CRDC research programs. Each panel comprises of approximately 10 individuals; however, this varies by program area. The membership of the panels are selective, in that specific members serve terms, often spanning many years on a specific panel. Turnover of panel members is gradual, where a new panellist generally replaces an outgoing panellist. As well as cotton growers, some panellists are also employees of cotton processing organisations

parameters for R&D investment decisions for the following 5-year period. This is developed by the Board of Directors in consultation with the CRDC's funders.

6.3.1. The design of long-term strategic plans

The strategic plan outlines the CRDC's broad strategic objectives, expected outcomes, and measures of success for its planned R&D investment for each 5-year period. It also describes the relation between the strategic objectives and operational R&D activities, by structuring the R&D portfolio into research programs. The design of the research programs then determines the structure of the internal management team, as Program Managers are each assigned a section of the portfolio (i.e. a number of programs) to manage. Thus, the selection of objectives is a key concern as it shapes the internal management structure and the composition and structure of the R&D portfolio. To show how this has changed over time, Table 12 lists the CRDC's strategic objectives and research programs, Figure 3 describes the number of open projects, and Figure 4 shows the level of research expenditure.¹⁴⁷

¹⁴⁷ For the purpose of comparability, I have classified the R&D program areas under previous plans using the classifications from the 2008–2013 plan.

Table 8: The strategic objectives and program structure in the CRDC long-term plans

Strategic objectives	Research Program	Program Type **
1991–1996		
Protect the crop against pests (insects, mites, diseases, and weeds) but with far less dependence on chemicals	Crop protection	Production
Develop and have adopted environmentally sound sustainable farming practices	Environmentally sound farming practices	Production
Develop new or improved cultivars	Breeding	Breeding
Reduce post-harvest costs and better meet market requirements	Post-harvest	Value chain
Maintain the effectiveness of the R&D effort	R&D effectiveness	Implementation/Extension
Improve the transfer of technology	Technology transfer	Implementation/Extension
Improve the availability/quality of human resources available in the R&D effort	Human resources	Implementation/Extension
1997/98–2002/03*		
To reduce the industry's dependence on traditional pesticides	Insect management	Production
	Diseases	Production
	Weeds	Production
To better manage and protect soil and water resources	Soils	Production
	Water	Production
To achieve Best Practice Management	Best practice management	Production
To ensure the cotton industry delivers economic and commercial benefits to the regional and broader community	Community and economics	Implementation/Extension
To improve farm management strategies	Farming systems and agronomy	Production
To develop cotton cultivars with improved fibre quality and agronomic characteristics	Plant breeding and biotechnology	Breeding
To improve cotton handling systems and processing	Processing and marketing	Value chain
To support efficient marketing and develop new market opportunities		
To coordinate and soundly manage the R&D effort and to strengthen human resources and research facilities	Human resources	Implementation/Extension

Strategic objectives	Research Program	Program Type **
To promote and support interactive transfer and adoption of improved technology	Technology transfer and extension	Implementation/Extension
2003–2008		
Improving the capacity of industry and the community to use the knowledge and innovations gained through research and development. A continuing culture of innovation in the cotton industry, which creates viable rural communities	People and knowledge	Implementation/Extension
Improved delivery of research, knowledge and management strategies related to natural resources that enhance the ecological, social and economic values associated with cotton production systems, both on and off-farm, and reduce negative environmental impacts	Integrated natural resource management	Production
Improved integrated management of major pests, weeds and diseases, reflected by continued reductions in chemical insecticide and residual herbicide inputs to crops, and responsible management of transgenic technology	Crop protection	Production
Integrated farm management practices that enhance the sustainability and profitability of cotton farming systems	Farming systems	Production
World leading cotton varieties displaying continuous improvement in cotton yield, quality and agronomic performance through plant breeding and biotechnology innovation	Breeding and biotechnology	Breeding
To produce high quality consumer preferred cotton and develop new international and domestic market opportunities	Value chain	Value chain
2008–2013		
Add value to the Australian cotton industry with premium products in improved routes to market	Value chain	Value chain
Cotton in a highly productive farming system with improved environmental performance	Farming systems	Production
A culture of innovation and learning	Human capacity	Implementation/Extension

NOTES: * Classifying the strategic plan during the CRDC's transition into its second long-term plan period is difficult, as initially the CRDC released a 1997–2002 plan but this was changed again in the creation of the 1998–2003 plan one year later. In addition the CRDC also attempted, in both variations of the strategic plan, a much more matrix structure between research programs and strategic objectives, whereby up to seven different research programs might contribute to one strategic objective. The classification shown is based on the structure used in the first annual operating plan in this period (1998/99) which shows the most relevant program for each strategic objective **The classification of these different programs has been developed in this study, examining the types of projects and outcomes of each research program.

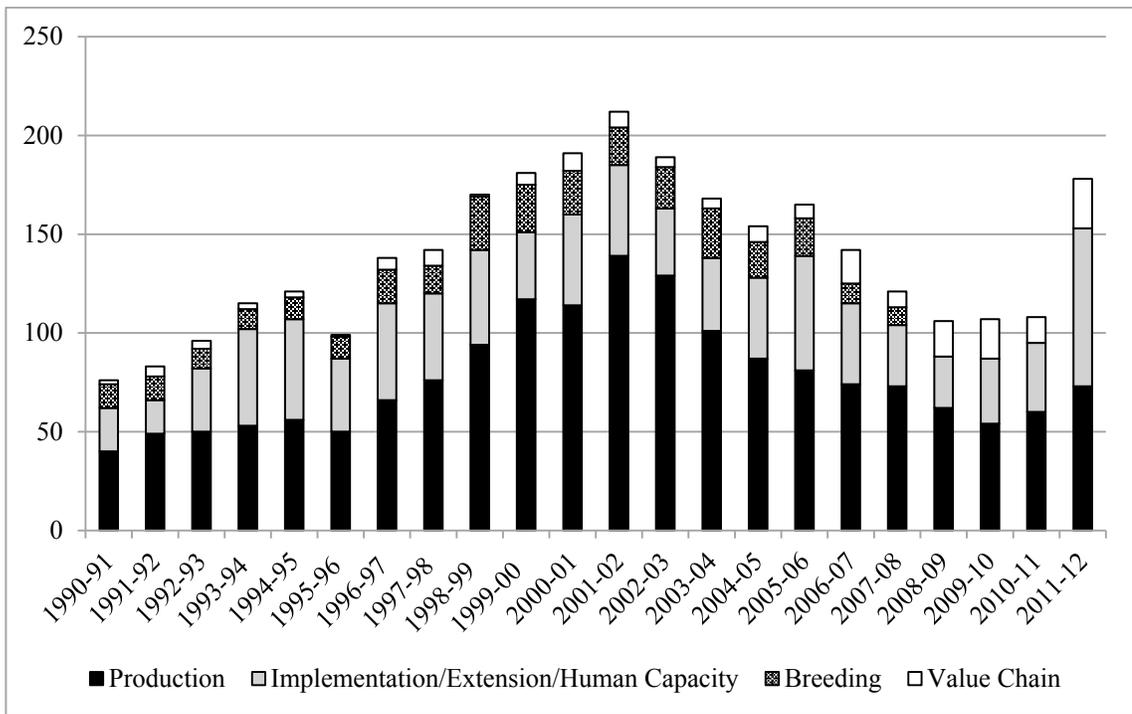


Figure 3: CRDC R&D projects by program type

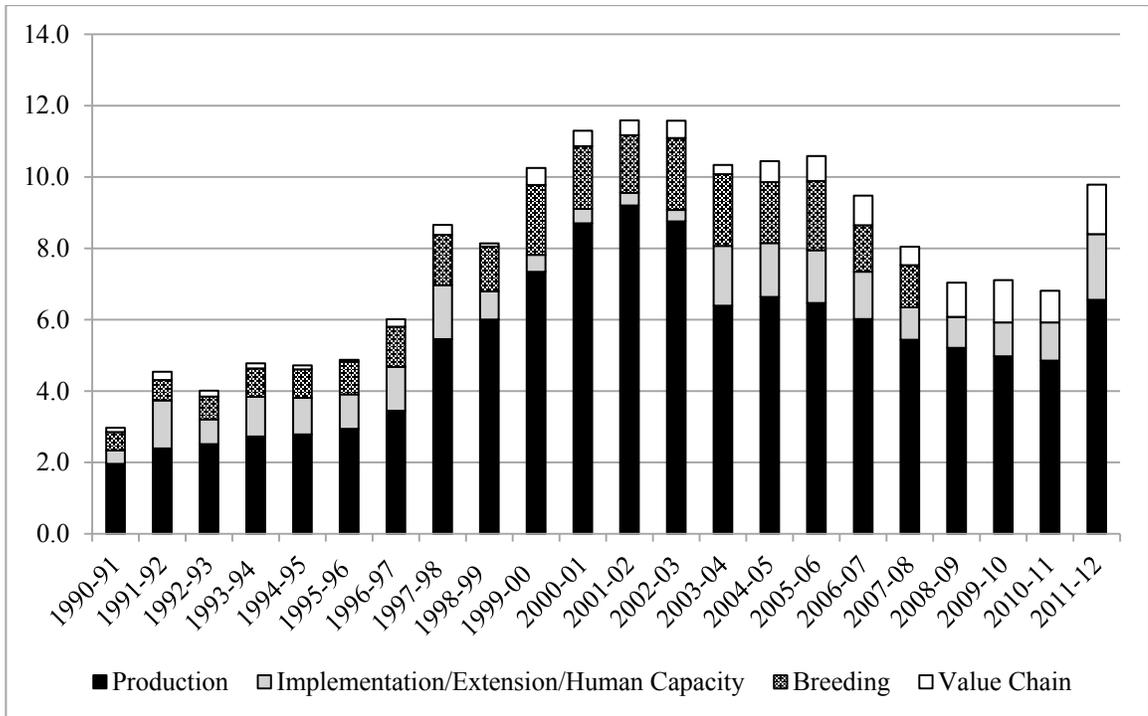


Figure 4: CRDC R&D expenditure (\$) by program type

NOTES: See Table 12 for classification of research programs into program types

The table and figures are consistent with the view that the strategic objectives and resulting investment decisions reflect concerns and priorities of the grower funders. As one manager commented:

We're not as easily able to invest in research that is not for growers. (CRDC Senior Manager)

The strongest indication of grower-funder interests has been the dominant focus on production R&D, including research areas such as: agronomy and farming practices, soils, water, crop protection, and implementation of a best practices management program. R&D projects in these programs have generally been highly capital intensive (e.g. conducted in laboratories, field trials, greenhouse experiments, regional surveys), or rely on data sets that can only be developed over numerous cotton growing seasons (e.g. disease, pest, soil or nutrition surveys). It has not been unusual for shorter-term three year projects to have been refunded consecutively, in effect creating programs that have run for up to 30 years.

Another area supported by growers was breeding and biotechnology research. This R&D developed new cultivars of cotton that had improved fibre quality or yield, and later genetically modified cotton that is resistant to one of cotton's main insect predators. However, since 2008 the CRDC no longer has been involved in this stream of research.¹⁴⁸

The third R&D stream relates to the value chain post-farm gate. This research initially sought to improve the profitability of operations post-harvest, the ginning and processing technology, and more recently explored marketing opportunities for Australian cotton. Initially value chain programs have been comparatively small; however, since the withdrawal from breeding research it has become a more significant focus, with its resource allocation doubling in 2008.¹⁴⁹

The table and figures also show the consistency in the CRDC's strategic priorities over time. Senior managers explained the need to balance the exploration of new areas yet

¹⁴⁸ It has since been conducted via a joint venture between Cotton Seed Distributors and the CSIRO.

¹⁴⁹ The final project type classified above as "implementation/extension" refers to a diverse range of activities including human resourcing needs of R&D and technology transfer. These projects largely fund non-permanent extension staff, scholarships, education programs, training, conferences, and awards. Most work in this area is conducted by private consultants or in-house by CRDC staff with few actual R&D projects.

maintain continuity, with the majority of planned investments developing from existing structures and objectives of the subsequent plan:

Some of the research we do is what we call new from existing, quite a lot of it. We can look at our current investments and I can say to you now – we're going to have a new plan – but I can say to you now that probably nearly half or two thirds of what we invest in, in the new plan, is going to be stuff that we're investing in now because it's dealing with some of our key threats. (CRDC Senior Manager)

The conservative approach towards strategic objectives appears to be based on an awareness of the long-term impact of these decisions. As one manager described:

We've got a new strategic plan, so if the Board said, well, we actually want to do something that's quite distinctly different, it's not a quick process to change the direction. We're not the Titanic, we're not that big that we can't turn but it does take a year – it does take a couple of years to change direction in a sensible way without it impacting on people's livelihoods and careers. You don't want to be insensitive to that sort of stuff. (CRDC Senior Manager)

Thus, the consistency in the strategic plans appears to represent an alignment between the demand for ongoing production-related R&D by grower funders and the need ensure sufficient capacity or supply of capable R&D providers.

6.3.2. Selection of the Board of Directors

The entity responsible for developing the strategic plan is the Board of Directors, which is comprised of a Chair, the Executive Director, and five to seven non-executive Directors. The non-executive Directors' term is 3 years, although it is not uncommon for directors to sit for two consecutive terms. Given the decision rights of the Board, the selection and appointment¹⁵⁰ of Board Members is considered a critical issue:

¹⁵⁰ The CRDC Board Selection Committee comprises of a presiding member (selected by the Minister), and four individuals nominated by Cotton Australia. The Board positions are advertised nationally, and candidates are assessed by the committee according to selection criteria developed through reference to the PIERD Act itself, as well as through consultation with the Minister and the CRDC. In the latest selection round in 2011, the entire selection process took a year to complete and cost nearly \$50,000 (advertising, secretarial expenses, travel and accommodation fees for chair) (CRDC 2012a, p.123).

The selection of the CRDC Boards is an important issue. We've got a new Board in there now, they were appointed last year. That's important that they're in tune. You've got to have enough people on that Board that know the industry and then you've got to have people that are thinking outside the square. It's really important that that balance in there is pretty right. (Cotton Grower)

Although the non-executive directors are nominated by an independent selection committee and approved by the Minister, it appears that the Board selection process represents a way for the government to exert influence on the CRDC:

This is one of the areas where you do get interference from Canberra...We were adamant what we wanted for this new Board and which we got in the end. You've got to be really careful, that's where Canberra can go 'oh, we've got to get someone in this job' and then you start to get people who might be good directors but they haven't got the interests of the industry at heart. (Cotton Grower)

This quote also highlights another concern that non-executive directors have sufficient experience and knowledge to make effective strategic and investment decisions. Historically non-executive directors were representatives of cotton organisations, government or research providers. However, because of a gradual shift to more 'independent' or 'skills-based' selections, approximately half of the current non-executive directors have no direct experience in the industry. This increases the time to train new Board Members about the industries R&D needs and to establish effective working relationships with the CRDC management team:

It creates some tensions and what their expectations are of us reporting to them. We've got used to reporting to the previous Board, we're [still] doing the same and they [the new Board Members] go, 'we want to know X, Y and Z'. (CRDC Senior Manager)

The Board selection process therefore prompts trade-off between ensuring the independence of decision makers on one hand, and the investments required to develop context-specific experience and tacit knowledge on the other.

6.3.3. Consultation processes

To prepare the most recent strategic plan¹⁵¹ (for 2013–2018) the Board began by collating information from a range of sources (e.g. industry-level strategic plans and reports¹⁵², internal program managers, Cotton Australia Panels, and members of large industry organisations, external consultants). This information was then used to analyse trends in the operating environment, including persistent issues as well as emerging priorities. Then a gap analysis of the existing portfolio was conducted to identify areas of strategic need for investment. During the drafting stages, the Board consulted with government and grower constituents who are highly influential in shaping the development and refinement of strategic objectives:

Well, if the industry is going, we don't want you to do that. That's just clear as. Or the government says, that's outside your scope, we're not anticipating you doing it. So those things are very clear. Then after that again it's negotiation... We have to take in a broad range of considerations and just not immediate industry needs. We have to take in the government's interest in a broad range of subjects as well. So that offers us an avenue to talk about long-term. It offers us an avenue to think about things that have less direct benefit to industry but are related. (CRDC Senior Manager)

As this quote suggests, the interests of the CRDC's two main funding sources do not always coincide – growers are more focused on short-term priorities whereas government interests tend to be broader and longer-term. For example, in the preparation of the latest strategic plan the funders' divergent interests manifest in an apparent trade-off between industry-focused R&D priorities and research that served a more general 'public good'¹⁵³ or community benefit:

¹⁵¹ As each plan is prepared by a different Board of Directors the planning process varies.

¹⁵² For example The Cotton Sector RD&E Plan and the 2029 Industry Vision and the Third Environmental Assessment and Cotton Australia's own strategic planning process.

¹⁵³ The focus on 'public good' during the last strategic plan arose out of concerns raised in a review of the entire Research and Development Corporation funding scheme by the Australian Productivity Commission that was published in February 2011. One of the main criticisms of RDCs was an imbalance in benefits arising from R&D for between those that were directly relevant to private industry rather than wider community and public.

When [the CRDC] was first set up ... the concept was to help farming industry where there's market failure in their ability to do research because they're all individual businesses. This is a mechanism through a compulsory levy and the Commonwealth will match it, to actually get a critical mass of investment to make research worthwhile. Therefore it is industry focused research. Whereas the government...has sort of said, well, we want some more tax payer good stuff to come out of that. So how is that benefiting the tax payer and we're putting our 50 per cent in, so now there's kind of an overlay of national interest type things. They're not always compatible. (Grower)

Compared to the high levels of consultation with government and grower groups, research providers had minimal involvement in the development of the latest strategic plan. Researchers indicated that while historically they had had more influence on the strategy of CRDC, this was no longer the case:

We, as an organisation, have probably lost our voice a little bit in that discussion because of different politics. In, for one, a lack of recognition of how much our organisation invests in research. Secondly, we're just not in the positions, we don't have a seat at the table in a lot of things. So there are decisions about research investment and those sorts of things going on and my boss ... doesn't even get a seat at the table. (Research Provider)

This view was confirmed by the CRDC managers. Although the annual report states that: "...the invitation has been extended to researchers and research organisations to contribute to the development of the CRDC plan" (CRDC 2012a, p.6), there had been only limited engagement with researchers. From the manager's perspective, these discussions had not been constructive:

In terms of engagement with strategic planning, there's an open invitation. So we've had a forum in March where we had two questions: what are the most important issues going to face the industry in the next five to 10 years? Second question was what R&D should we do to solve them? I'm sorry, they didn't behave very well. They were all about their tenure. It was all very individual. They couldn't think that way.... We don't get a lot of engagement that way, so then we have to go back when we've got our draft strategy. (CRDC Senior Manager)

One of the issues you have with researchers, they're not very strategic, most of them. They'll start thinking about the science which is great but get them to think outside the box a bit and, you know... (CRDC Senior Manager)

The CRDC's lack of engagement with providers in the strategic planning process was seen as problematic by researchers for several reasons. First, it disregarded the expertise of scientists to be able to project what future R&D investments would be needed in the industry, which overlooked historical instances where significant breakthroughs came from the input of providers rather than the industry:

They didn't come to us and say, well you need to go and get BT cotton¹⁵⁴ to market here. We went to them to say, we would need to get this technology from overseas to put out into the industry. The ideas on integrated pest management didn't come from the industry, they came from the research providers. They're saying, you need to do this, same with disease resistance, same with fibre quality. The future change for requirement or demand for fibre quality is something that we had advised more than 10 years ago in terms of the markets. (Research Provider)

Second, it overlooked the financial contributions and mandate of some of the large research agencies to drive and do publically funded research:

We're the ones investing in and driving lots of the research. The perception is that all the direction needs to come from industry. Yet, the reality is – well, not the reality – there has to be some direction coming from us. We're the doers of research, not just the providers to other people, because we are being supported by the public as much as those other people. So there's as much public investment in what we do for the Australian people, if not more, than ...other research funding providers and that message is often lost as well. (Research Provider)

Third, the lack of consultation was perceived by researchers as antagonistic and detrimental to a collaborative relationship between provider organisations and the CRDC:

¹⁵⁴ BT cotton is a genetically modified variety of cotton that produces a toxin which kills natural predators of the cotton plant.

As far as I'm concerned, a successful industry would be one where that was something that was done as a collaborative partnership...So the success we've had so far has been down to partnerships and collaboration and communication. It has been evolving and has got to a point where it has become the opposite of all of those things, sort of dictatorships and things imposed upon you. No, we're not going to fund that, those sorts of things without discussing them before the point of decision is reached. (Research Provider)

I'm concerned when I look forward. I look forward strategically about environmental issues or pests or diseases and I look at the sort of politics and I look at the industry politics, I'm scared. Well, if you extrapolate from where we used to be with the relationship between CRDC and research providers, where we are today and where we'll be in that same amount of time, we'll be at war. That's a frightening thing. (Research Provider)

An additional problem, not raised by interviewees but apparent in the patterns of CRDC R&D project contracts over time¹⁵⁵, is that the CRDC is heavily reliant on a very small concentration of organisations and individuals in terms of its ability to execute its R&D plan. The CRDC contracts with a wide variety of organisations (e.g. universities, publically funded research centres, private consultants); however, the vast majority of all their R&D activities, particularly in production-related program areas, are conducted by six provider organisations.¹⁵⁶ Furthermore, within these organisations, there are at least 15 individuals who have been the nominated chief investigator of at least 10 different CRDC funded projects.¹⁵⁷

The reliance on this small group of organisations and individuals appears to have emerged as a result of the CRDC's emphasis on 'cotton-industry relevant' R&D. As projects are often tailored towards issues that are highly specific to cotton growing, researchers need expertise not only in the relevant scientific discipline (e.g. agronomy or entomology), but in topics that are particular to cotton (e.g. particular insect predators, the agronomy of the

¹⁵⁵ These were compiled with reference to project lists available on the CRDC website and in annual reports.

¹⁵⁶ Including the CSIRO (several different departments), NSW Department of Primary Industries (NSWDPI); Queensland Department of Agriculture, Forestry and Fisheries (QDAFF); the University of Sydney; and the University of New England. Also, since 1993, the CRDC has been a major partner of the Cotton CRC, and has subcontracted over 150 projects (discussed further in Chapter 7).

¹⁵⁷ This is a conservative estimate and does not count instances where a researcher may contribute to a funded project (e.g. as doctoral supervisor) and not be the nominated chief investigator.

cotton plant, or the fibre qualities of cotton). Furthermore, the potential pool of researchers the CRDC can contract is relatively small because they need access to project-specific resources such as specialised equipment, laboratories, greenhouses, as well as suitable farms for field-trials; be willing to re-locate to cotton growing regions; have detailed understandings of the methodologies of longitudinal projects (i.e. disease surveys, soil surveys, nutrition experiments) and have access to past data sets; have tacit, experiential knowledge of how the CRDC contracts research and the expectations of R&D projects; and have credibility and established relationships with grower funders.

The execution of the CRDC strategic plan therefore relies heavily upon the specialised human capacity of a small group of research agencies. Rather than manage this dependency through an alignment of strategic planning with provider organisations, the CRDC considers provider's interests and negotiates R&D investments at the operational level of individual project decisions.

6.4. Annual operational planning and investment decisions

The strategic plan is operationalised through project investment decisions made by the CRDC Board, who allocate funds towards R&D projects conducted by external research providers. These decisions are made each year as part of the Board's preparation of the annual operating plan, which outlines how the CRDC will achieve its long-term strategic objectives through the continuation of existing¹⁵⁸ and newly funded projects.

The majority¹⁵⁹ of new projects are selected through a two-stage proposal process (depicted in Figure 5). This process begins when the CRDC makes an annual call for preliminary research proposals (PRPs), which in turn are reviewed and evaluated by the Cotton Australia (CA) panels and Program Managers, before the Board selects projects that are invited to make a full research proposal (FRP). The FRP stage is much the same, albeit much more extensive; providers provide more information about their project¹⁶⁰, and the

¹⁵⁸ Most R&D projects run for between 1–3 years and thus form part of several annual operating plans.

¹⁵⁹ A small number of projects are initiated as commissioned projects; this will be described later in the chapter.

¹⁶⁰ Preliminary research proposals are 3 pages in length while full research proposals are approximately 20–30 pages.

panel and program manager evaluations are more detailed. The process concludes when the Board select the projects to be funded and prepare the annual operating plan to be approved by the Minister of Agriculture.

The 10 steps for the cotton industry's annual 2-stage R&D procurement round		
Table 2 STAGE ONE		
Step 1	Research proposals invited for the annual R&D Procurement Round of cotton industry R&D investments. Advertised nationally, details on CRDC website (www.crdc.com.au). Researchers Handbook published.	June 3
Step 2	Preliminary Research Proposal (PRP) for: <ul style="list-style-type: none"> • Research, Development & Extension • Scholarships Submit a Full Research Proposal for: <ul style="list-style-type: none"> • Travel • Major Capital Items PRP CLOSES	July 12
Step 3	All PRPs are reviewed by the industry Panels and CRDC R&D Program Management	Early August
Step 4	Results of industry's review are submitted to CRDC	Mid August
STAGE TWO		
Step 5	Advice to successful and non-successful applicants Successful applicants are invited to complete Full Research Proposal (FRPs)	End of August
Step 6	FRPs submitted to CRDC by applicants	October 25
Step 7	CRDC evaluates FRPs for recommendation for investment	November to January
Step 8	Successful and non-successful applicants advised	Early March
Step 9	Contracts are developed and issued	March to June
Step 10	Projects commence	July 1
Cotton Research & Development Corporation.		Handbook for Researchers 9

Figure 5: CRDC two-stage proposal process

(Source: CRDC 2012b, p.9)

In the sections below I will detail mechanisms used in relation to specific aspects of this process including project development, project evaluation, and the project selection decisions.

6.4.1. Project development

The development of prospective projects to deliver the CRDC's strategic objectives is facilitated by three key mechanisms: the open call and two-stage proposal process; the negotiation tactics by Program Managers; and the representative panels.

The open call and two-stage proposal process

The development of new project designs begins with the annual call inviting all prospective providers to submit preliminary research proposals (PRPs)¹⁶¹ for consideration in a competitive grant process (see Figure 6).

CRDC Preliminary Research Proposals (PRPs)

CRDC is calling for new research investment proposals. Investments by industry address three strategic areas.

Cotton Industry value chain
Cotton, irrigation farming systems
Human capacity, social research

CRDC invests in a wide range of research and development projects aimed at enhancing the environmental, economic and social performance of the Australian cotton industry.

Preliminary research proposals are now being accepted for R&D investment support from CRDC beginning 2011/12.

Projects may relate to any field of cotton related research and development but are not limited to CRDC's three strategic R&D programs as above.

Applicants are advised to seek CRDC and industry input before compiling their proposals. The CRDC website has full details on how to apply and how to address the Corporation's strategic objectives as detailed in the Strategic R&D Plan 2008-2013.

Figure 6: Example of call for PRPs

¹⁶¹ In this application, providers nominate the relevant CRDC program and strategic objective which their proposed project would address; provide a project concept and rationale for investment; describe the project's functional operation, i.e. its design, methodology, personnel and links to other collaborations; nominate the R&D objectives and expected science and industry outcomes; outline a commercialisation or adoption strategy; list any background Intellectual Property (IP) or potential IP arising out of the project; and develop a preliminary budget specifying, for each of the 3 years of the project, the expected amount of cash investment from the CRDC and cash or in-kind contribution from the R&D provider.

To ensure that projects are designed to suit funders' interests, researchers are required to develop projects that address objectives outlined in the CRDC strategic plan. The actual design and scope of projects, however, are left intentionally open:

Our procurement of research is really centred around an open call each year. It's an open invitation for anyone to pitch an idea that might be worthy of the industry investing in.
(CRDC Program Manager)

This more open, provider-nominated approach to research design is thought to encourage providers' sense of ownership of R&D projects:

I'm glad we're in an industry¹⁶² where we've got a strategic plan that's got a diversity of space in it. We've got an industry that has a diversity of issues and there's a lot of opportunity for people to pitch niches to work in cotton. Then it's about how well they pitch their ideas and the strength of their ideas and their commitment to them...I do like the fact that we have an open call because it's about their ideas. That's our platform then to build from. (CRDC Program Manager)

In addition, the openness of the call and the two-stage proposal process enables the CRDC to maximise the number and diversity of research applications. As researchers are able to pitch their own ideas, the CRDC is able to access a range of different technological options. Coupled with the abstract nature of the CRDC's strategic objectives, this gives the CRDC some flexibility in responding to emerging opportunities that they might not have anticipated at the time of the strategic plan's formation:

So it's adaptive; the plan is at the core of the process to start with but that doesn't preclude anything identified – because it's an open call process, it doesn't preclude anything new or different that wasn't there or especially addresses an emerging need that wasn't envisaged.
(Cotton Australia Manager)

In addition, the initial PRP stage provides the CRDC with an opportunity to assess a wide range of projects, without significant burden to either the provider or the evaluators. The PRP stage was introduced during the resource-constrained drought period. The rationale

¹⁶² This contrasts with more competitive tendering models used in some other RDCs, where providers bid for specific projects designed by the funding body.

was that while researchers were less likely to receive funding, they were potentially still willing to submit a much shorter initial proposal. Although fewer providers were eventually funded, having a PRP stage allowed the CRDC to maintain contact with its existing pool of applicants. The success of the PRP as a recruitment and screening tool has meant that it remained even once the CRDC's financial position improved.

Program Manager negotiation

To strike a balance between strategic fit and provider ownership, there is substantial emphasis on Program Managers to guide the development and negotiation of suitable project design through the two rounds of evaluation by the Cotton Australia panels and Board. At the early stage of project development, researchers are encouraged to develop personal relations with the relevant Program Managers, who can communicate tacit or implicit expectations about potential projects:

I want to start to build that relationship between our researchers and ourselves for us to say, 'if we're going to achieve this plan and get done what we need to get done, you need to understand the sorts of things that we're looking for'. You need to come along and be part of that, and if there are good ideas out there then we've got the resources to support that. But if we say, nah, or, maybe if you tweaked it this way, we really do mean it. (CRDC Senior Manager)

Armed with first-hand knowledge about the nature of the project, the Program Managers are also on hand when the CA panels meet to discuss the PRPs and FRPs, to provide additional information. They then gather the panels' feedback about the relative value of each proposal and recommendations for how the project could be modified to better suit grower needs, which they combine with their own evaluations to present to the Board.

Although the selection and investment decisions are made by the Board, the Program Managers will often be present to answer additional questions. The Program Managers are also responsible for feeding back the results of the Board decisions to the CA panels and for explaining decisions which went against the panels' advice. They are also responsible for relaying the decision outcomes with research providers, explaining why projects were not selected and advising the successful applicants about how projects may need to be adjusted:

What we're trying to get them to do is to think what their research represents in terms of benefits to the industry. We're constantly trying to challenge them with that. Some of it is in the form of ... we'd like you to demonstrate X, Y and Z. We'd like you to describe that better.
(CRDC Senior Manager)

In providing this feedback Program Managers still place a strong emphasis on working collaboratively with providers to ensure that the project strikes a balance between funder and provider expectations:

So once the Board has approved the project, they might put certain conditions on it and might say we need to reduce the budget by X per cent. You then have to work directly with those research providers to negotiate and hopefully agree that a research proposal meets the provider's needs, what they think is important, and what the Board has set as the parameters. (CRDC Program Manager)

During development of an individual project the Program Manager therefore appears to act as a 'go-between' for the research provider who designs the project, the CA grower panels who provide 'industry advice', and the Board of Directors.

The representative panels

The involvement of the CA panels ensures the interests of grower-funders are factored into the negotiation and selection of projects. At both stages, panellists individually review each proposal before meeting to discuss the value of the project, ask questions, suggest improvements and develop decision recommendations::

So it's basically, we've got panels of farmers that review the research proposals and give opinions on where they believe the funding should be spent. At the end of the day, the Board of the R&D Corporation makes the decision but they place a lot of weight on what the farmers want. (Cotton Australia Manager)

The CRDC would be silly to go completely against the Cotton Australia group...At times they may say, well, we want to fund this area anyway on a certain thing, and Cotton Australia wouldn't really try and stop that. But if they were missing key areas of research ... I think there would be a fuss because Cotton Australia can go straight to the minister. That's the ultimate threat...to go to the minister and say, well, look, we're not happy with

what the CRDC is doing, they're not listening to us. So it's in CRDC's interest to follow that... (Cotton Grower)

As these quotes describe, although the final selection decisions reside with the Board, the panels provides grower representatives with an opportunity to voice their views about what specific projects are funded by their levy to the CRDC.

6.4.2. Project evaluation

To inform investment decisions, the Board relies on project evaluations conducted by grower panels as well as the internal Program Managers.

Grower panel evaluations

The grower panel evaluations do not follow any standardised process or template. Individual panellists develop their own systems for reviewing proposals, and then at collective meetings the participants volunteer their opinions in relatively free-flowing and unstructured discussions about each project. Although there are no set criteria for evaluating each project, there are several reoccurring issues that feature in panellists' assessments of projects. These include: the relative significance of the central issue addressed by the project; the capabilities, reputation, and strategic significance of the research personnel; the feasibility of the method; the appropriateness of the budget; the adequacy of information provided; the fit or redundancies with existing projects; the long-term consequences of investing in certain areas¹⁶³; and the willingness of the research provider to adjust the FRP in light of comments given about the PRP.

At the FRP stage, the meetings also conclude with the panels assigning each FRP a score, relative ranking, and investment recommendation, taking into account the expected funds available for investment. The panels attempt to frame final investment recommendations regarding the entire program area, including advice regarding projects that are considered 'must invest', as well as a relative ranking of those that could be funded if the Board had an appetite for risk.

¹⁶³ For example, the need for further investment in subsequent research, the potential to commercialise, or issues relating to regulatory or intellectual property.

One of the concerns in relying on representative panels is whether individuals will value issues that do not affect them directly. To overcome this, new panellists are exposed to informal induction activities to encourage them to adopt a more ‘representative’ mindset:

So, I guess, when a new representative of a member is appointed, I try and take them through a bit of an induction process and keep an eye on them for a year or two and talk to them about their role whenever I get a chance, and some of the others do too, quite informally. But part of that is trying to get them to realise that even though they're from Moree or Hillston that they've got this role to reflect, not just their farm, their own needs, but the needs of their region versus the needs of the industry. (Cotton Australia Manager)

Another concern is the volume¹⁶⁴ and technical sophistication of the scientific information panellists are expected to evaluate:

It's how to take people with very limited time and actually develop their capacity in an area. We know research levy funds are being spent in this area. So they have a stake, how to get their contribution to be an effective contribution and make their advice worthwhile, is the challenge. It's a challenge across the whole thing but it can be difficult in the soft science area and it can be difficult in the really hard science as well. (Cotton Australia Manager)

As well as having the CRDC Program Manager available to answer questions, panellists also receive training by Cotton Australia, as part of panel induction processes, as well as on ad-hoc basis. The panellists tend to develop expertise and knowledge of science related to their program area over time; however, problems exist for new areas of science or investment:

So there are challenges in everything, some of the modelling stuff can be a bit challenging. But the genetic and the molecular stuff are difficult. So people often reserve their judgment. So they'll give advice that's highly conditional on the fact that they don't really understand what the science is. (Cotton Australia Manager)

Thus, despite the training the panellists receive, there is often significant information asymmetry between the panel evaluators and the R&D providers.

¹⁶⁴ The amount of time panellists spend reviewing PRP and FRP proposals is recorded informally by Cotton Australia personnel, and equates to approximately six weeks full time equivalent each year.

Program Manager evaluations

The Board relies heavily on the project evaluations conducted by Program Managers, which are condensed into standardised project evaluation forms. These evaluations include criteria-based information, such as ranking the project's alignment with the strategic plan, its financial returns¹⁶⁵, and Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis:

We've got a series of questions we use that we then rank and produce a kind of a spider graph – the smaller the cluster is around the centre of the spider graph, the better the project is from our point of view. (CRDC Senior Manager)

The Program Managers also develop their own opinion about the project, based in their own experience and knowledge about the researcher applicant and previous R&D that has been done. In forming this assessment, Program Managers look for indicators that the project will be completed, such as the design of the project and the capabilities of the personnel:

There's two drivers of uncertainty: how well-proven the method is in answering that style of question drives uncertainty and, in that too, just how well-developed the method actually is, whether part of the project is actually to develop a scientific method or whether it's to use an established method. ... If it's an established method, has it been established for answering this style of question? That drives uncertainty... Then there's an uncertainty that's driven by researcher skill, relevance and experience in the style of questions and methods being applied. (CRDC Program Manager)

To evaluate the 'researcher capability', they consider the researchers' reputation, their performance in previous projects, and the degree to which the project teams' capabilities, strengths and expertise appear to match the project aims and questions. Experienced researchers also tend to be favoured as they benefit from having skills in the grant application process itself, and being able to develop projects that balance science discovery and industry relevance:

¹⁶⁵ This is either calculated in terms of a crude return on investment, or a description of the impact in triple bottom line.

You just end up knowing that people with those skills tend to describe better projects that need less interaction... They can end up identifying the question on their own, they know it will be of interest to industry, and they can structure a project in the way that you can clearly see, yes, and they're going to be able to do all of that. It just becomes an inherent skill. (CRDC Program Manager)

Projects with less experienced researchers, such as PhD students, are still considered. However, they are assigned a higher risk ranking which factors into investment decision and the subsequent management of a project.

The other factor affecting managers' assessment of risk is the size of the project, with CRDC preferring to invest in many smaller projects, rather than larger ones. This is because smaller projects are perceived to create greater accountability for researchers to complete than larger team-based projects:

The other thing that we can do because we're a small organisation, which I think is important, is that we can have small projects and lots of them. We're not afraid of that. We wouldn't work to prevent that. That actually means then that we only have a limited number of projects with more than one researcher in a project. That means then there are a lot of researchers who drive their own destiny. They have their own project. If it succeeds or fails, 'I was in charge of it as much as I can within my own organisation'. (CRDC Program Manager)

The relative risk of project completion is then assessed against its strategic need, in which Program Managers take into account the urgency of the issue being addressed and the relevance to industry. To make this assessment they rely on feedback from the panels, who provide the CRDC with insight into the scale or significance of different issues, both in terms of the relative importance as well as the extent of the industry it may affect (i.e. farm specific, regional or whole industry):

The growers do a really good job of helping us get the scale of an issue and help us to try and understand, well, yes, that's a really big issue and actually we do end up with four or five projects across that issue. The total spend is well over a million dollars, that's probably going to still be quite feasible. They're still going to be quite comfortable with that. Whereas, if an issue's small or only regionally relevant, then you've really got to fit the style

of investment to the scale of the issue. That kind of process helps us a lot with that. (CRDC Program Manager)

As panellists typically have long involvements in the cotton industry, they have historical knowledge about prior issues, which also feeds into managers' assessment of whether a project addresses persistent or more ad-hoc problems:

It might be a one in 10 year issue and [the CA panel] remind you that it was around 10 years before your time. It never turned into this big, hairy monster – then that helps you say, okay, well, we need to just take on board what's already known about this and tailor this more to the scenario, make sure we've scoped. It sort of helps you fit the style of investment to the issue that's really important. (CRDC Program Manager)

The panellists' evaluations thus provide the Board with access to a broader historical and institutional knowledge, which feeds into their own judgements about the value and significance of different proposals.

6.4.3. Project selection and investment decisions

Ultimately it falls to the Board to select projects for investment. Making these decisions is challenging because the risky and uncertain nature of the projects makes it difficult to predict which projects are likely to deliver what they set out to achieve, and which projects are likely to be the most value to the industry:

The nature of research itself means that you might think you know where you're headed with something but you'll get a result that says, you got that wrong, you're going to have to go and look at something else. You can't ever assume that you're going to get all the answers you think you will when you start a project. Something transformational might come out of a research project that you did not expect...You don't always know whether you're investing in a bit of research that actually turns out to be transformational. So I'd say there are only a few examples of things that have been transformational in the industry and the research was done because we didn't know the answers. (CRDC Senior Manager)

The CRDC attempts to mitigate the risk of poor investment decisions by providing the Board with an extensive amount of information described in the previous sections, including information embedded in the proposal documents, the panel evaluations, and the

Program Manager assessments and recommendations. Also, the Board is guided by the parameters of the strategic plan. However, this tends to be applied flexibly as there is awareness that other issues, not anticipated at the time of the strategic plans development, may arise and warrant attention:

In terms of looking at R&D, I guess we use the plan as a bit of a guide. It's inevitable that when you get to the point of a plan where you've got some initiatives identified in it, that you'll hit the mark with some and others you'll find are useless by the time you get to them in five years. That always happens. I don't know how you get rid of that... (CRDC Senior Manager)

In addition, projects are considered as part of portfolio-based decisions. That is, although projects are assessed on their individual merit, eventually all investment decisions require a relative weighing up of different project alternatives:

We also look at, we contemplate alternatives, the counter-factual. Where we can see, because often we get to decision-making that's based on budgetary allowance too, where we get to the point where we can't have all of this and all of this has good things in it. (CRDC Program Manager)

There are several portfolio-level considerations which the Board will weigh up and consider, including certain balancing of the type of R&D projects funded; and the impact of investment decisions on the ongoing relation with its providers.

Balancing trade-offs between different types of R&D projects

Although the project proposals tend to be highly diverse and idiosyncratic, when making portfolio level investment decisions the Board and managers consider a range of trade-offs between different types of R&D. For example, this occurs in when weighing up projects that are ‘defensive’ – such as bio-security research – which prevents threats from occurring; and those which are ‘offensive’ – such as improved crop production techniques – that seeks to add value to crop production. Whereas it is easy to justify offensive R&D in terms of the tangible outcomes it could generate, the investment case for defensive R&D can seem less compelling as ‘success’ “is nothing happening” (CRDC Senior Manager). Likewise, grower

panels and commercially-oriented Board Members also seem to favour short-term, industry-focused, low risk projects, over longer-term, more basic, high risk initiatives. There is the danger that if project investment decisions are made in isolation (i.e. without broader portfolio considerations), then the resulting program would be dominated by very low-risk, industry focused, consultancy style research, at the expense of more long-term, potentially transformational research programs:

Then you're trying to balance that between some short-term issues with some long-term issues as well...to say, we know that our technology might take 10 to 15 years to come to fruition. But if we're starting to invest in something now then we wouldn't be expecting that it will achieve anything for 10 to 15 years but we have to look at that investment and go, is it important to spend that now as opposed to some issue that happened last season, and then be seen to be responding to that, so all the way trying to juggle that. (CRDC Senior Manager)

Portfolio balance is maintained through the overarching parameters of the strategic plan, as dedicated research programs or sub-programs tend to support different styles of research. Furthermore, portfolio balance also features within the Program Managers' evaluation of projects, and their advice they provide to the Board.

Consequences of investment decisions for relations with research providers

When selecting projects for investments, the CRDC Board may also consider how investment decisions affect their on-going relations with individual research providers. For example, they may decide to fund a particular researcher because they possess certain expertise that would be hard to replace:

When we sort of get down to that project against project level assessment, you end up with scenarios where on the things you consider is the value of types of expertise to the industry, short-term and long-term. It's not about the actual person. It's about the type of expertise they have. Yes, because you do have to make choices. (CRDC Program Manager)

The need to preserve the CRDC's 'human R&D capacity' embedded within its supplier network appears to be complicated by three factors. The first factor, described earlier, is the

CRDC's desire to fund R&D that is tailored specifically towards the needs of the cotton industry, which limits the potential pool of research providers. Second, is the CRDC's variable revenue stream, which limits its ability to provide continuous funding to all providers within its portfolio. This was made evident during the recent drought, where the CRDC had to prioritise funding to projects and researchers that they considered 'core':

So a lot of our investment, particularly through the drought period ... was identifying what our core R&D was in those sorts of areas. It became quite difficult...But we had to go through that exercise with our previous Board to say, well, we might get down to only five million dollars of total R&D investment. What's our core R&D, and it was starting to get down to how we invest in things that manage those risks. (CRDC Senior Manager)

This had a short-term impact of limiting the pool of research providers; but it also had a long-term effect as it disrupted its ability to manage its succession planning. As most of the 'core providers' were senior researchers, who have since started approaching their retirement, the CRDC faces a short-fall of experienced, cotton researchers to take their place:

So when we're coming out of it now, there's a whole heap of Baby Boomers – that were going to retire anyway – but we haven't been able to do the succession thing well, because of that. So it's even more difficult now. There were researchers that probably left that we didn't replace with other researchers. So then again the gene pool gets a bit smaller. You don't get to be as adventurous in your portfolio. Your risk profile comes back. (CRDC Senior Manager)

The result is that the 'small gene pool' limits the CRDC's ability to explore new research areas and creates a high reliance on its current providers:

We'll be coming up with ideas and we'll be going, how the hell are we going to get that done? Who are we going to find that can provide that research?... It is difficult. And then you've got this idea that we're all working so closely together than you can't even almost contemplate working with someone else which wouldn't be good. The gene pool gets too small. (CRDC Senior Manager)

Finally, the third factor is the short-term duration of project contracts, which, according to providers, do not adequately match the time commitment required to develop meaningful R&D outcomes:

If we get somebody here and we say, look, we don't see that there is anything beyond the three year cycle, so make sure that you focus and deliver on outcome, writing papers up and get ready for the next job, no problems. But dealing with the longer-term vision is the hard one when I know that I need people here that are thinking beyond the three year project and then they're faced with the funding cycle all the time. It's just really hard...It's hard on the individuals and hard on the people who have to tell them they don't have jobs all the time. (Research Provider)

As this quote illustrates, the three-year project durations are perceived as disruptive because they provide no assurance of continuity beyond the current project. Discussions with providers revealed that due to the timing of investment decisions, they may receive only a few weeks' notice that the funding for their position was not going to be renewed. This is particularly acute for contract researchers in science agencies, who were reliant on project grants for employment. Although current contracted researchers often had made significant personal and professional investments to re-locate to the region to do cotton related R&D, they were circumspect about the potential need for them to either change their professional focus or potentially move away¹⁶⁶ if their next project contract was not funded.

These combination of factors, as well as with the lack of strategic consultation (see Section 6.3.3), has contributed to significant tension between the CRDC and some of its 'core' research providers. From the providers' perspective, their concern is that the CRDC is able to leverage their position to insist on the direction of the research:

The reality is that whilst we get resources over here [Provider's own R&D funding], we need the resources from over here [CRDC funding] and if we don't have both, nothing happens and that's where the tension comes in. So you become almost answerable to this because – and they've got that leverage because they know without them, this doesn't exist, it disappears.... Even though it's 50/50... And that's where the tension is. So they hold the

¹⁶⁶ Another factor is the regional geographical location of cotton R&D sites. If researchers based in these regional areas are not funded by the CRDC, then there is limited other employment opportunities.

cards in many ways on many initiatives. That's where we, in our planning, often have to make the decision, do we do something that we don't agree with or we don't fit with or do we do something that's not funded enough to do. (Research Provider)

From the CRDC's perspective, core providers are able to exploit their position by increasing the proportion of the project paid by the CRDC:

We do have some projects that have been reasonably long-term, looking at now maybe the start of the third project in a particular area. It becomes really challenging when we see just suddenly the total budget doesn't change but our contribution to it jumps by 20 to 40 per cent. All that is a change in head office in an R&D organisation that says, oh well, this is industry benefit so we charge them more. No consultation, it just comes in the budget. So we find that pretty challenging. (CRDC Senior Manager)

We're not here to support the notion that we maintain the livelihood of researchers. It's the other way around. Researchers sustain the livelihood of growers. End of story. There's no other story. If your research doesn't do the job, then sorry. We've had a very good – attitudinally – quite a strong shift. We're very much focused on delivering against those legislative commitments. We invest for the public good and we invest for private good. Very simple. (CRDC Program Manager)

Although these problems were still ongoing, the CRDC had begun to alter the way it contracted with its core providers, through adjustments to the project design and selection process. These will be described in the following section.

6.4.4. Alternative project development and selection processes

Although the majority of all new projects are developed and selected through the PRP/FRP process described in the previous sections, there are a few instances where these processes are modified. It appears that the CRDC uses these alternative project initiation strategies to alleviate some of the problems in ensuring balance across the portfolio and contracting with core providers.

Commissioned projects

Instead of relying on the call and proposal process, the CRDC occasionally commissions projects by contracting and negotiating with a provider directly. They may do so to address a ‘gap’ that a Program Manager identifies in the strategic plan:

One of the roles that we have is also supposed to be a bit more proactive and strategic rather than just being passive and waiting for research providers to submit applications. We need to identify gaps, so if we feel there's an issue that's not being addressed, either in an existing project and no one else has identified it, we need to then go and find appropriate people to provide a tender against what we see is a gap. (CRDC Program Manager)

The CRDC may also commission projects to fund the strategic development of certain capabilities or skills within their supplier network, either by mentoring existing researchers in a new research area, or alternatively sourcing new contacts through other funding agencies.

Core provider project design and selection

Recently the CRDC has begun to experiment with adjusting its selection processes and project design parameters to address some of the concerns expressed by its core providers. For example, a small number of ‘core researchers’, with their established track record of numerous successful CRDC projects, are nominated by Program Managers and invited by the panels to skip the PRP stage, and simply provide an FRP. As a result their FRPs are initially ranked higher than others at the start of the second round of evaluation. The rationale is that while the PRP stage is useful for providing feedback to new or inexperienced researchers, this group of highly experienced researchers are likely to develop a valued proposal and will not benefit from the early rounds of feedback:

We don't really want them spending time writing a three page outline because we know they're highly valued researchers to the industry and we want them to concentrate on providing a good proposal in November. (Cotton Australia Manager)

In addition, certain projects are being earmarked as ‘core projects’, which typically are the long-term production related projects, which have been consecutively funded for several

decades. In order to achieve a better match with the length of the project the CRDC is offering researchers' longer duration for funding renewals, extending it from three years to five:

One of the things we are starting to look at doing is identifying those core projects which we see as ones that are really important because it does give us that ongoing knowledge and capacity. So we're looking to start funding those for five years, rather than three, so they don't get treated in the same way. ...They tend to be very agronomic kinds of projects, around some of the soils work and of the insects work. (CRDC Senior Manager)

As this manager describes, these 'core projects', which are strategically significant in terms of the tacit knowledge embedded with the individual research providers, are treated differently to other transactions within the CRDC portfolio.

6.5. Management, monitoring and reporting of R&D activities

The execution of the R&D plans is monitored at two levels: at the level of individual projects and at the level of the entire CRDC entity.

6.5.1. Project-level monitoring and management

All projects are monitored by the relevant program managers through a set of standardised reporting processes (Figure 7 outlines the project reporting schedule).

For example, all researchers are required to prepare a progress report every six months. This summarises the activities and key findings of the project, and reports progress against in-process milestones and objectives set out in the project contract. These are reviewed by Program Managers who assess the likelihood of the project achieving its agreed outcomes, or the need for some sort of intervention:

We're trying to assess in terms of what the project said it would do, what it's actually delivering, how we assess in terms of have we achieve everything we can under this strategy in a plan, or is there still stuff that needs to be done. Will it go well beyond the plan in terms of delivery? (CRDC Senior Manager)

Schedule of Reports & Payments		
Due	Purpose	When
November	Bi-annual Progress Report—Provides an update on the first 5 months of the project in the financial year. <i>Basis of project review and approval for continuing investment allocation.</i> <i>Opportunity to amend budget for following year.</i>	Yr 1, 2 & 3
May	Bi-annual Progress Report for the Financial Year	Yr 1 & 2
Quarterly	Milestone payments, quarterly payments	Upon receipt of milestone reports (refer to Table 4 for further detail).
40 business days	Financial reporting	For all projects, 40 business days after the end of each financial year.
	Surplus funds at the end of a project	Invoiced by CRDC to researcher's project administrator.
60 days	Travel report	60 days after travel or conference end.
60 business days	Final Report and Final IP Schedule	Yr 3 - 60 business days after the ceasing of a project.

Figure 7: Project reporting requirements

(Source: CRDC 2012b, p.12)

In addition to progress reports, researchers are also required periodically to submit financial and travel reports, as well as a final report after the conclusion of the project. Providers must comply with these reporting requirements in order to receive contract payments from the CRDC, which are paid quarterly.

Program Managers complement their review of these different standardised reports with more relational-based monitoring, particularly for projects that are known to constitute a higher ex ante risk:

I suppose the bigger the investment associated with something that we consider risky, the more intensively we'll try and work with the organisation to manage the project. (CRDC Program Manager)

They will typically liaise with provider organisations if a particular project is experiencing problems or appears to be falling behind, interacting with the different individuals involved:

As much as possible we would try and manage the relationship with the research organisation because we would want people who are working in projects supported by CRDC to be well-supported by their own organisation. We don't actually have that. It's not something we're in control of. We would try and always cultivate that culture in the way we work with those organisations. (CRDC Program Manager)

However, the CRDC Program Managers are constrained in their ability to intervene in the direct management of projects, as it falls beyond their control; instead they rely on the research provider organisation to operationalise the project:

We trust everyone to go off and do what they say they're going to do. (CRDC Program Manager)

In part, the CRDC managers rely on individuals' felt accountability for projects, which is strengthened by features of the project development and selection such as the provider-nominated design of the project and the use of smaller project teams with less layers of responsibility:

We don't have very many researchers who ultimately work for another researcher. We have a few but not a lot. Most of them are by choice. It's not that we would never give them a project. That's the choice that they've made is to be structured like that. So I think that's pretty important too, is that we don't look to try and, well, you guys are all working on wheat. You should all work in one project. We're happy to have three projects all working in a complementary space but, you know, you're responsible for this bit, you're responsible for this bit and you're responsible for this bit. We like the fact that you all work together. We would expect to see some overlap, some conversation in your project reports, and stuff that interact with each other. We're not going to worry about who's stealing glory from who here. Ultimately you've got some stuff that you can hang your hat on, you've got some stuff you can hang your hat on, and so have you. (CRDC Program Manager)

In addition, the perpetual nature of the CRDC's investment cycles does create more long-term incentives for providers to ensure contracts are met because:

... if a project underperforms, it's not just a reflection on the researchers driving the project. It's a reflection on the way that organisation manages their teams and manages the performance of their research. (CRDC Program Manager)

The detrimental effect of contract non-compliance on a provider's overall reputation thus creates incentives for each provider to ensure each transaction is managed and delivered effectively.

6.5.2. Monitoring and reporting on R&D investment at the portfolio level

While the Program Managers are responsible for managing project-level investments, the Board monitors the progress of the CRDC as a whole in delivering against its annual and strategic plans. They monitor the operational management of the CRDC through regular Board meetings where the CRDC internal management team reports on how the CRDC is progressing in terms of 'achieving against the plan' (CRDC Senior Manager):

We're always reporting to the Board in terms of the strategic plan, that's kind of how we report to the Board. Just Board progress reports go through things that are happening and issues that are cropping up within the plan. (CRDC Senior Manager)

The Board then reports periodically about CRDC's progress to parliament, the minister and the peak industry body, through the preparation of its quarterly financial reports and annual report. These documents are prepared according to a checklist of specific elements. For example, the annual report includes financial statements, governance reports, progress against strategic goals/milestones, and a report of research activities. The CRDC management team prepare the report carefully against the checklist so as to ensure they remain 'under the radar' (CRDC Program Manager).

6.6. Chapter Summary

In this chapter I have presented the case description of the CRDC arrangement – an entity that has been operating under legislation to invest funds from Australian cotton growers and government into individual short-term R&D projects conducted by external research providers. To fulfil this role, the CRDC has relied on three inter-related processes. First, its R&D investment was shaped by the long-term strategic planning cycle (described in Section 6.3), in which an independent Board of Directors determined the broad strategic objectives in consultation with funding representatives. This long-term planning process was then operationalised through an intensive annual planning process (described in

Section 6.4), in which prospective research proposals submitted by external providers were subject to two rounds of review, development and evaluation by the Board, internal managers and grower representatives. The third process (described in Section 6.5) related to the ex post monitoring and reporting of R&D outcomes, which was accomplished by through the review of individual project progress reports and the annual reporting to the CRDC's funding constituents.

Chapter 7: The Cotton Cooperative Research Centre (Cotton CRC)

7.1. Introduction

The aim of this chapter is to present my case description of the Cotton Cooperative Research Centre (Cotton CRC). In Section 7.2 I outline the history of the Cotton CRC; which has been operating since 1993 under the Cooperative Research Centre Program. In Section 7.3 I then outline the main mechanisms that have shaped the set-up of the CRC arrangement, including the bid application, partner-level agreements, and the CRC responsibility structure. This followed by a description of the operational planning and investment processes that determine the development and selection of individual project contracts. Finally in Section 7.5 I describe the range of monitoring and reporting mechanisms used to manage the achievement of project-level and centre-level R&D outcomes.

7.2. Background and overview

The Cotton Cooperative Research Centre (Cotton CRC) is a collaborative inter-organisational arrangement involving federal, state and local government agencies; universities; the CSIRO; the CRDC; local catchment authorities; cotton industry bodies; grower representative organisations; and commercial organisations involved in the cotton industry. It was established to enable members of the cotton industry to secure an additional source of funding for cotton-based R&D¹⁶⁷ and establish a new R&D arrangement that formalised relationships between industry groups and a broader network of research providers.

¹⁶⁷At the time, this additional pool of funds was significant in enabling investment in a broader scientific technological research base to support the rapidly expanding industry, and to compensate for the drought-induced contraction of CRDC revenue.

7.2.1. The CRC Program

The Cotton CRC was first established in 1993 under the Commonwealth Government's Cooperative Research Centres (CRC) program.¹⁶⁸ The program awards grants to fund the formation of collaborative R&D partnerships. The CRC Program was initially aimed to build Australia's scientific capacity – in terms of physical infrastructure and research personnel who could contribute to technological development outside academic institutions – and to encourage collaboration between publicly funded researchers and private sector end-users. Its designer, Professor Ralph Slatyer (Chief Scientist) described the vision for the program as:

... a Centre which would be something of a "One Stop Shop" for innovation, consisting of a cooperative team of researchers and research users, drawn from various organisations, and of adequate size and composition to have a real and continuing impact in the sector where it was located. ... I thought that all user participants should have access to the research in the Centre, so the competitive challenge for individual firms would be to utilise the research results in-house, ahead of others. With that in mind I hoped that more than one firm would be associated with each Centre so that it would not become the research arm of a particular firm and opportunities for commercial joint ventures would be more likely to arise... (Slatyer 2000)

7.2.2. The three Cotton CRCs

Under the CRC Program rules, each CRC entity is designed to have a limited life of seven years, during which its participants aim to achieve pre-specified R&D outcomes and objectives. In somewhat of an anomaly, the Cotton CRC was renewed twice, in effect creating three Cotton CRCs that ran consecutively for 18 years, from 1 July 1993 until the 30 June 2012. As can be seen in Table 9 – which presents some descriptive information about the three Cotton CRCs – each successive entity grew larger in terms of the resources contributed; the number of participating organisations; and the size and scope of the arrangements' R&D portfolio.

¹⁶⁸ The CRC Program was initially administered by the Department of the Prime Minister and Cabinet and was then incorporated into the Science portfolio, which shifted through various government departmental restructures. At the time of the third Cotton CRC, the program was administered by the Department of Innovation, Industry, Science and Research (DIISR).

Table 9: The three Cotton CRCs

Name	The Cooperative Research Centre for Sustainable Cotton Production	The Australian Cotton Cooperative Research Centre	The Cotton Catchment Communities Cooperative Research Centre
Years of operation	1993-1999	1999-2005	2005-2012
CRC Resources:			
Commonwealth CRC Grant	\$9.0	\$12.4	\$26.5
Cash contributions from (core) CRC participants	\$1.2	\$4.2	\$31.1
In-kind contributions from (core) CRC participants	\$62.9	\$67.7	\$98.3
Cash from supporting/non-core CRC participants	\$2.5	\$14.6	\$14.3
In-kind contributions from supporting CRC participants	N/A	N/A	\$15.4
Funding Total	\$75.6m	\$98.9m	\$185.6m
Organisation structure	Unincorporated joint venture	Unincorporated joint venture	Company limited by guarantee
No. of core partners (and affiliates)	6	12	11
R&D activities:			
No. of R&D projects (excl. education ,training or adoption)	86	146	219
No. of HDR students funded	15	37	64
R&D programs	Four: Sustainable management of the resource base; Farming systems; Crop protection; Breeding	Five: Sustainable Farming Systems; Innovative technologies; Managing and Enhancing Agricultural Ecosystems; Growth in Northern Australia; Cotton textile research	Four: Farm; Catchment; Communities; Product
Other programs	Education, transfer and adoption	Education and Technology Transfer	Education and Training; Adoption

7.2.3. CRC funding and partner organisations

The Cotton CRC resources comprised of funding from the government's grant¹⁶⁹ and the resources contributed by participating organisations, such as cash and in-kind contributions of capital and personnel.¹⁷⁰ Resources were allocated towards R&D projects; education, technology transfer or communication initiatives; and the administrative cost of the CRC entity. The CRC grant was provided as a lump sum; however, contributions from participants were, in some circumstances, 'tied' to specific projects and could not be re-allocated without the consent of the original contributor.

Over time, the value of partner contributions grew with the increase in the number of participating organisations, particularly following the change in the entity's legal status.¹⁷¹ The first CRC formed as a joint venture involving six partner organisations; this expanded to 12 in the second CRC, with the addition of several government and commercial organisations. As the third CRC was established as a company limited by guarantee, it could collect funds from different types of contributors. The contributions of 11 'core partners',¹⁷² were supplemented by funds contributed by 34 additional affiliates¹⁷³ who were not bound to the requirements of being a partner. Table 10 and Table 11 summarise the contributions of these different organisations.

¹⁶⁹ Since 1991, the CRC program has funded 200 CRCs, with the Australian government contributing over \$3.8 billion. CRC participants have contributed a further \$11.7billion in cash and in-kind support (Department of Industry 2014).

¹⁷⁰ Participants made in-kind contributions by allowing the CRC use of infrastructure or assets they owned or by paying salaries of staff in their own organisations to work for dedicated periods of time for the CRC.

¹⁷¹ Under the CRC's rules, each CRC must comprise of at least of one Australian end user and one Australian higher education institution, but may also involve other parties, such as federal, state and local government, commercial organisations, and industry bodies.

¹⁷² "A party to this agreement and the Commonwealth Agreement other than the Company" (Cotton Catchment Communities CRC 2005, p.12). Initially there were 12 core participants, but the merger of Cotton Australia and the ACGRA in 2008 reduced the number to 11.

¹⁷³ "An organisation that committed contributions to enable the Centre succeed in obtaining Commonwealth funding and whose contributions are outlined in the Commonwealth Agreement but who does not sign the Commonwealth Agreement" (Cotton Catchment Communities CRC 2005, p.9).

Table 10: Contributions by the core partners of the three Cotton CRCs

Core partners contributions:	CRC 1	CRC 2	CRC 3	R&D Provider
CSIRO	In-kind	In-kind	In-kind	Yes
University of Sydney	In-kind	In-kind	Cash and in-kind	Yes
University of New England	Cash and in-kind	Cash and in-kind	Cash and in-kind	Yes
NSW Department of Agriculture/NSW DPI	In-kind	In-kind	In-kind	Yes
Queensland Department of Primary Industries and Fisheries/QDEEDI/QDAFF	In-kind	In-kind	In-kind	Yes
CRDC	Cash	Cash and in-kind	Cash and in-kind	No
Western Australia Department of Agriculture		In-kind	In-kind	Yes
Cotton Seed Distributors		Cash and in-kind	Cash and in-kind	No
NT Department of Business, Industry and Resource Development		In-kind		Yes
Queensland Cotton		Cash and in-kind		No
Western Agricultural Industries		In-kind		No
Twynam Cotton		Cash and in-kind		No
University of New South Wales				Cash and in-kind
University of Technology Sydney			Cash and in-kind	Yes
ACGRA/Cotton Australia Ltd			Cash and in-kind	No
Total no. of core partners		6	12	11

NOTES: 'Core partner' refers to the parties of the joint ventures in CRC1 and CRC2; and parties who are identified as 'core participants', as distinct from the 34 'affiliates' or 'supporting participants' in the CRC3. 'R&D Provider' denotes whether partners conducted R&D projects for the joint arrangements (this does not include non-R&D projects such as extension or education projects).

Table 11: Contributions from affiliates of the Third CRC

Affiliate/supporting participants	Contributions
Ag Biotech Australia Pty Ltd	Cash and in-kind
Aquaculture Association of Queensland Inc.	In-kind
Aquatech Consulting Pty Ltd	Cash and in-kind
Australian Cotton Shippers Association	Cash
Australian Cotton Trade Show Trust	In-kind
Australian National University	Cash and in-kind
Border River Gwydir Catchment Management Authority	In-kind
Boyce Chartered Accountants	In-kind
Central Queensland University	In-kind
Central West Catchment Management Authority	Cash and in-kind
Charles Sturt University	Cash and in-kind
Condamine Catchment Natural Resource Management Corporation Ltd	Cash
Conservation Farmers Inc.	In-kind
Cotton Consultants Australia Inc	Cash and in-kind
Department of Environment and Resource Management (DERM) (QLD)	Cash and in-kind
Department of Infrastructure, Planning and Natural Resources	In-kind
Dunavant Enterprises Pty Ltd	Cash
Grains Research and Development Corporation	Cash
Greening Australia Ltd	Cash and in-kind
Griffith University	In-kind
Incitec Pivot Limited	Cash and in-kind
International Fibre Centre Limited	Cash
Inverell Shire Council	Cash
La Trobe University	In-kind
Millmerran Shire Council	Cash
Monsanto Australia Ltd	Cash and in-kind
Namoi Catchment Management Authority	Cash and in-kind
Narrabri Shire Council	Cash
Narromine Shire Council	Cash
Orica Australia Pty Ltd	Cash
Queensland Murray Darling Basin Committee	Cash and in-kind
Southern Cross University	In-kind
Sunwater	Cash
Sustainable Irrigation Systems	In-kind
Telstra Corporation Limited	Cash and in-kind
Terrabyte Services Pty Ltd	In-kind
The University of Adelaide	In-kind
The University of Queensland	Cash and in-kind

The cash and in-kind contributions from all participant organisations – commercial end users, government and research provider organisations – were recognised in the CRC’s consolidated financial statements. This co-contribution model reinforced the view that the CRC arrangement was intended to constitute a network of R&D partnerships.

7.2.4. The Cotton CRC R&D provider network

CRCs are network structures designed to bring together researchers from several R&D organisations to address key objectives, which was evident in the way people described the CRC:

*Everyone is actually employed in another organisation who has generally signed up to the participant's agreement... All those people are part of the CRC. Now sometimes there'd only be [contributing] five per cent, other times there'd be 100 per cent... But it just means that they're generally working on projects that are relevant to the industry and **we're the umbrella organisation that pulls everyone together...** How they choose to do it is up to them. But usually what it means from our perspective in terms of CRC is that it just creates this **massive network of people** who have made some commitment in terms of their time, even if it's only five per cent, that you can then draw upon to help with whatever. (CRC Senior Manager)*

*...they come together as the CRC, they feel part of something broader. They're not necessarily really signed onto the outcome but they're signed onto the **loose group** which is known as 'the CRC'. (CRC Senior Manager)*

*The CRC is **the mortar and the brickworks**. The big organisations, the CSIRO, DPI [Department of Primary Industry], the universities, bring their bricks to the table and the CRC provides the glue to physically do that. That's the beauty of the collaboration. (CRC Senior Manager)*

It appeared that this network arrangement overcame different, divergent, even competitive interests of the organisations involved. For example, one manager commented that:

... you didn't have the bickering and carry on because everyone's got different priorities and different objectives that they're trying to achieve. So I think that's what makes it work and it makes it easier, particularly if you're a researcher, to be able to put different hats on and it gets you over state boundary issues and all sorts of things. (CRC Senior Manager)

The 'state boundary issues' the manager refers to were the geographical priorities of the state agricultural departments to focus on regional issues specific to their own constituency. These interests were perceived to lessen within the CRC:

... if you're in Queensland you can come to New South Wales and no questions asked, and New South Wales researchers can go north without any problems. It [the CRC] overcomes all of those boundaries. (CRC Senior Manager)

In another example, providers who normally were in competition with one another to obtain project funding from the CRDC would work together on joint CRC projects or share information with one another:

The work that's been done collaboratively with CSIRO, QDAFF [Queensland Department of Agriculture, Fisheries and Forestry] and New South Wales DPI, when they wanted to be talking about weeds, for example, they could come together under the hat of the CRC and there was a reason for them to talk and share their information because it was in the name of actually achieving that goal. (CRC Senior Manager)

These accounts reveal a perception by Senior Managers that the CRC arrangement was successful in encouraging cooperation between the partner organisations involved. To explore how this occurred, in the following sections I will trace the mechanisms and structures used to set-up the entire entity, as well as the individual project activities it administered.

7.3. The set-up of the CRC arrangements

Given the diversity of organisations involved in the Cotton CRCs, it would seem likely that one of the more contentious issues would be deciding what types of R&D would be funded through the arrangements. This was addressed through a range of mechanisms used during its set-up to formalise its scope and centralise decision-making.

7.3.1. Formalising of the broad scope of each CRC entity

Each Cotton CRC was structured as a large project organisation, with objectives, outcomes and R&D activities organised in individual projects that were grouped in several research programs. The results of individual projects aggregated towards the achievement of the CRC-level outcomes:

The CRC is a little different insofar as you have a project which is delivering an outcome but its part of a specific outcome that other projects actually deliver towards. (CRC Senior Manager)

Although they ran consecutively, the three CRCs were established as distinct standalone entities, each with a different mission, objectives, outcomes, partners, and R&D portfolio. Thus the set-up phase of each CRC prompted the various governmental, commercial and scientific organisations involved to consider, justify and finally agree upon the purpose, scope and operation of the arrangement. This was achieved through the development of the bid application, which once approved became formalised in the two associational contracts: the Commonwealth Agreement – between the participating organisations and the Commonwealth Government; and the Participants Agreement – between each of the core participants (the ‘Agreements’).

The bid application

The main mechanism by which government funders were able to exert influence over the nature of the CRC’s activities was through the criteria embedded within the multi-stage bid application process.¹⁷⁴ Competing bid applications were awarded on the basis to which prospective CRCs address governmental expectations for the CRC program. The early aims of the CRC program focused on the need to enhance and expand the nation’s overall scientific and technological research capability; however, over time, greater emphasis was placed on supporting R&D that could benefit end-users and had commercialisation potential. Thus, in 2004, the third CRC’s bid was assessed according to criteria such as the likelihood of the CRC being able to generate outcomes that “contribute substantially to Australia’s industrial, commercial and economic growth” and returns that “represent[ed] good value for the taxpayer”.¹⁷⁵ Also, from the government’s perspective, in order for the latter two CRCs to gain renewal, they needed to demonstrate how they were different compared to their predecessors.

These government expectations were reflected in the changing nature of the mission, strategic objectives and R&D activities of each successive CRC. These strategic

¹⁷⁴ The bid process began with lodgement of a notice of intent 18 months prior to potential commencement of operations, followed by submissions of a preliminary business case and a full business case, then interviews for shortlisted applications. Some of the material prepared for these stages included a written business case, a detailed budget, several different power point presentations (including additional material to support question and answer sessions), and several promotional videos.

¹⁷⁵ “1. The outcomes will contribute substantially to Australia’s industrial, commercial and economic growth. 2. The path to adoption (commercialisation/utilisation) will achieve the identified outcomes. 3. The collaboration has the capability to achieve the intended results. 4. The funding sought will generate a return and represents good value for the taxpayer” (CRC Australia 2004, p.6).

objectives are summarised in Figure 8 and Table 12. For example, to deliver end-user research, the Cotton CRCs invested in research programs targeted around cotton production, such as crop protection, efficient resource usage and sustainable farming practice, and increasingly, research extension and education initiatives. In the latter two CRCs, the research programs expanded to include research about cotton production in northern Australia; cotton textile research; environment and sustainability research; and applied social science research aimed at examining the impact of cotton production on communities. These more distinct program offerings distinguished each subsequent CRC and demonstrated intent to deliver outcomes to a wider range of constituents. However, as will be discussed later in the chapter, the need to deliver R&D in these other areas required the CRC to invest and manage activities that its partners had little experience in.

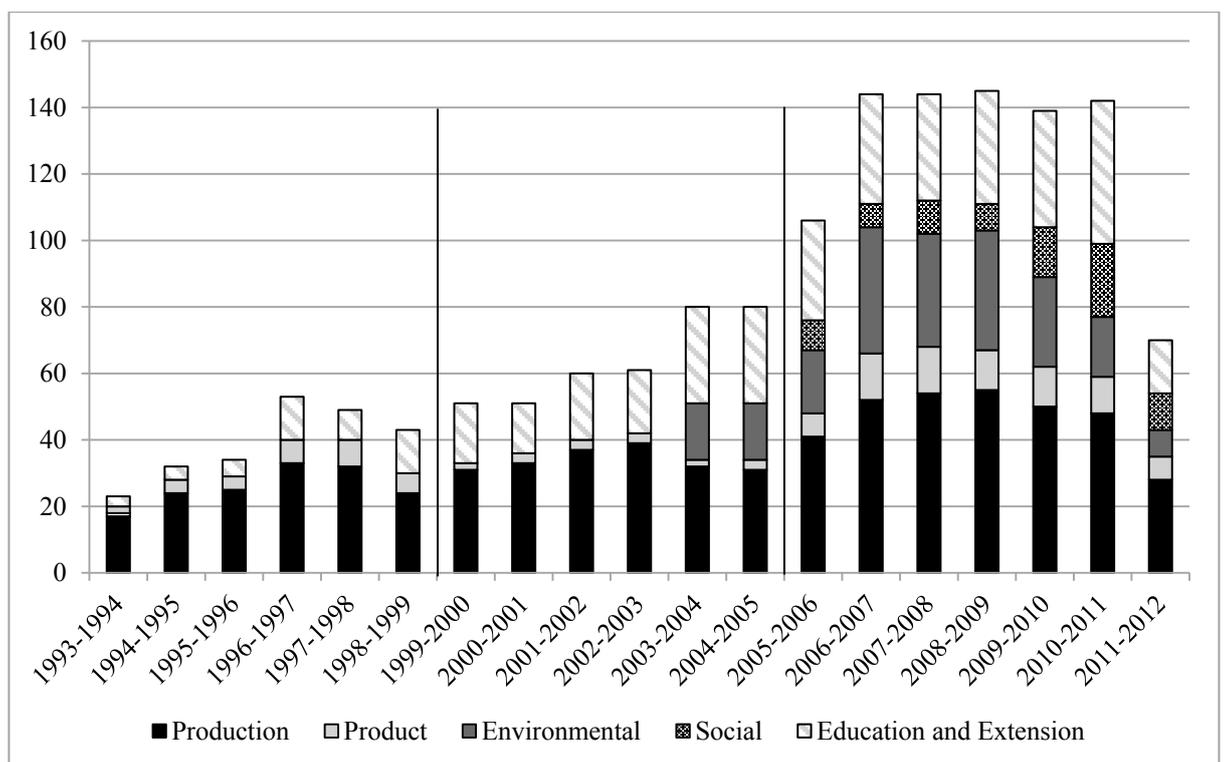


Figure 8: Number of open projects¹⁷⁶ in the Cotton CRC, by broad program category

¹⁷⁶ As most R&D projects within the CRC operated over multiple years, e.g. lasting 2-3 years, ‘open’ projects refers to projects that either commenced or continued their operation in that year.

Table 12: The strategic objectives and program structure of the three Cotton CRCs

Strategic objectives	Research Program	Program Type **
The Cooperative Research Centre for Sustainable Cotton Production (1993-1999)		
To develop sustainable management of the resource base	Protecting the Resource Base and the Environment	Production
To develop sustainable and environmentally responsible crop protection practices to manage insects, weeds and diseases	Crop Protection	Production
To breed and develop commercial cotton varieties adapted to Australian conditions	Product Development	Product
To enhance and promote awareness and adoption of new technologies to growers, consultants and the community	Education, Transfer and Adoption of Technology	Education and Extension
To develop sustainable production systems from the scientific outcomes of resources, protection and crop improvement*	Cropping the Field	Production
The Australian Cotton Cooperative Research Centre (1999-2005)		
To enhance the prospects for expanding cotton production by researching viable and environmentally responsible production systems for new regions in Western Australia, the Northern Territory and North Queensland	Growth in Northern Australia	Production
To research and develop innovative technologies which provide an improved range of options for environmentally acceptable crop management and bioremediation	Innovative Technologies	Production
To develop strategies for cotton production that encourages efficient use of resources while minimising inputs and the impact on the environment.	Sustainable Farming Systems	Production
To have a coordinated national network for extension, support and educational services to the cotton industry	Education and Training	Education and Extension
To develop innovative technologies for bleaching, Dying and other aspects of cotton processing for use by local and international spinning industries	Cotton Textile Research	Product
To enhance the cotton farming environment by reducing environmental impacts and to maximise the contribution of cotton farms to catchment health*	Agriculture Environment	Environmental
The Cotton Catchment Communities Cooperative Research Centre (2005-2012)		
To enable the cotton industry to improve profitability and sustainability of production	Farm	Production
To enable best practice cotton enterprises to deliver sustainable ecosystems and reduced impacts on catchments	Catchment	Environmental
To enable mutually beneficial interactions between industry and regional communities.	Communities	Social
To enable the industry to produce high quality consumer preferred cotton	Product	Product
To increase the adoption of new knowledge and enhanced decision-making capability of people working in or with the cotton industry, its catchments and communities	Education and Adoption	Education and Extension

NOTES: *Some research programs were added mid-way through the relevant CRC's term: Cropping Systems in the first CRC and Agriculture Environment in the second. ** To enable comparison, program type has been determined using the classification of the third CRC.

The Agreements

The Agreements established shared expectations between the partners, about the operations, objectives, structure, relations between parties, resources, financial management, reporting, project management, intellectual property (IP), and risk. While some questioned the efficacy of preparing such detailed plans¹⁷⁷ before the bid was approved, many people regarded the Agreements as central to facilitating cooperation between entities, for several different reasons.

First, in signing the Participants Agreement, the partners explicitly agreed to terms which legally bound them to collaborate and work together:

*...the Parties intend for the Company to be a non-profit scientific institution to...b) ensure that the Parties with their differing disciplines and backgrounds will, through their participation in the Centre, **add value to each other so that the performance of the Centre will be greater than that of each Party acting independently**; ...[and] d) **promote a managed and cooperative approach to research and education in the Centre Field so as to maximise the benefits from that research and education...**(Centre Objectives, Participants Agreement, Cotton Catchment Communities CRC 2005, p.17-18, emphasis added)*

Second, the Agreements formalised the collective purpose of the CRC. The joint outcomes were outlined in the overall mission, outcomes and objectives, which the partners all agreed to work towards:

I think the main thing that makes the CRC work is the fact that when it first got set up it had some defined outcomes that it wanted to achieve and it got all the partners to sign up to all those outcomes. They then were things that everyone knew was going to happen. (CRC Senior Manager)

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 which stipulate

¹⁷⁷ The Commonwealth Agreement and Participants Agreement were respectively 123 and 332 pages long.

what you're going to achieve as a collective. It really drives collaboration, drives that communication. (CRC Senior Manager)

Third, the Agreements provided a highly detailed operational plan for all of the CRC's activities ('Schedule of Activities').¹⁷⁸ The overall outcomes were disaggregated, by program and sub-program, into much more specific goals, outputs, milestones and expected completion dates:

...it was probably a bit more certain with the CRC because we had milestones, we had an agenda, it wasn't going to change in seven years... the CRC is set up and you pretty much know what research you're going to invest in at the outset and so each milestone would relate to a project. (CRC Senior Manager)

Furthermore, the Agreements specified how each participant was expected to contribute towards the attainment of the overall joint outcomes of the CRC. In addition to the Schedule of Activities, the contracts contained a detailed 7-year budget accounting for the contributions from each of the participating organisations and the allocation of resources towards each of the R&D programs and the administrative expenditure, as well as a list of 'Initial R&D projects'¹⁷⁹ that partner providers agreed to conduct. This reduced the scope of negotiation with partners once the CRC commenced operation:

I think because all the organisations have signed up to the achievement of those objectives, it gives all people in those organisations a bit more certainty because all the contractual details have already been hashed out in the Participants Agreement and they all know what they're up for and what they've agreed to do and why this project gets funded ... (CRC Senior Manager)

¹⁷⁸ The Schedule of Activities contains a description of CRC outcomes (and its alignment with National Research and Economic Goals); a governance and management plan (including the key positions, how risk will be managed, and how the centre will enable effective collaboration); a commercialisation and utilisation plan (outlining target markets, communication, operational extension and technology transfer strategies, commercialisation governance arrangements, the specified commercialisation personnel and the private sector participants, and the commercialisation program); a description of each of the R&D programs; and detailed outcomes, targets, outputs and milestones.

¹⁷⁹ The Participants Agreement contains a list of approximately 50 initial projects that partners commit to before the commencement of the CRC.

The Agreements also provided strategies for commercialisation, creation, distribution and rights to IP developed within the CRC, which mitigated the risk of conflicts. Finally, the Agreements also specified the nature of the internal management structures and the capacities of the central entity to make decisions and enact control over projects. This will be explained in more detail in the following section

7.3.2. Granting discretion to central CRC entity

Once the CRC commenced operation, the Agreements vested much of the decision-making and control in the management structure of the entity itself. This structure has evolved throughout the three arrangements (see Figure 9, Figure 10 and Figure 11).

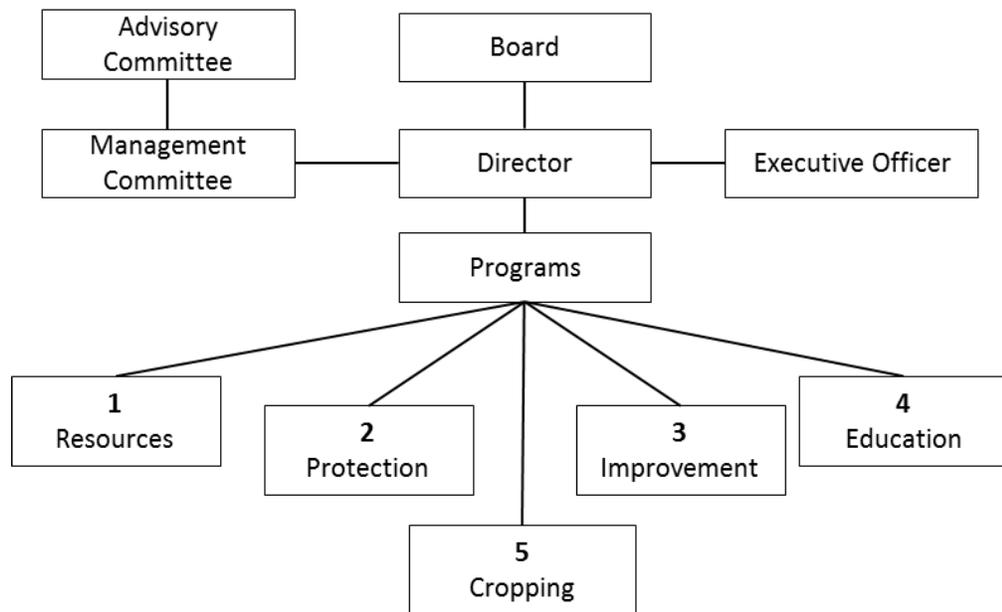


Figure 9: The management structure of the first Cotton CRC (1993–1999)
 (Source : Cooperative Research Centre for Sustainable Cotton Production 1998, p.6)

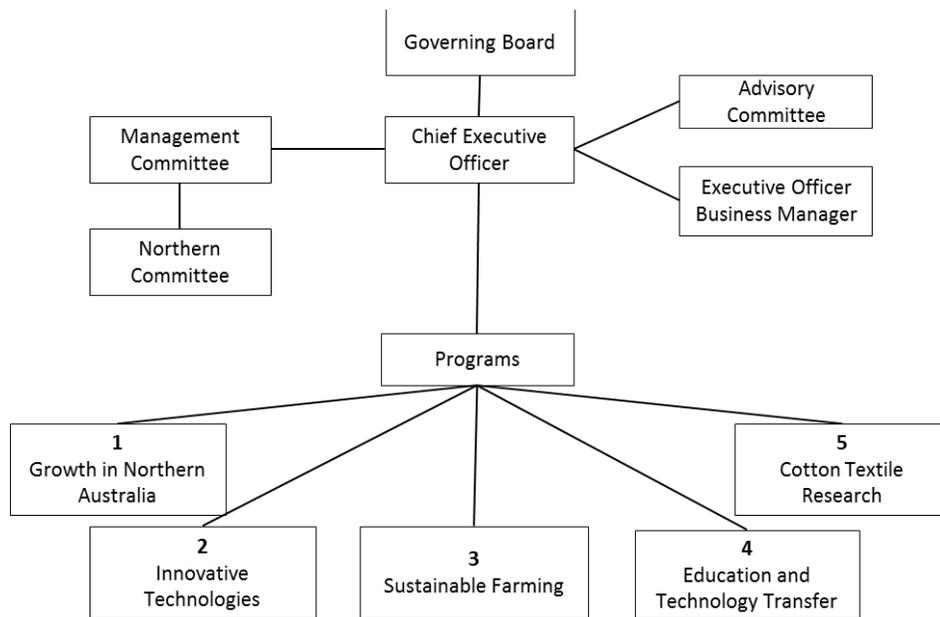


Figure 10: The management structure of the second Cotton CRC (1999–2005)
 (Source :The Australian Cotton Cooperative Research Centre 2000, p.10)

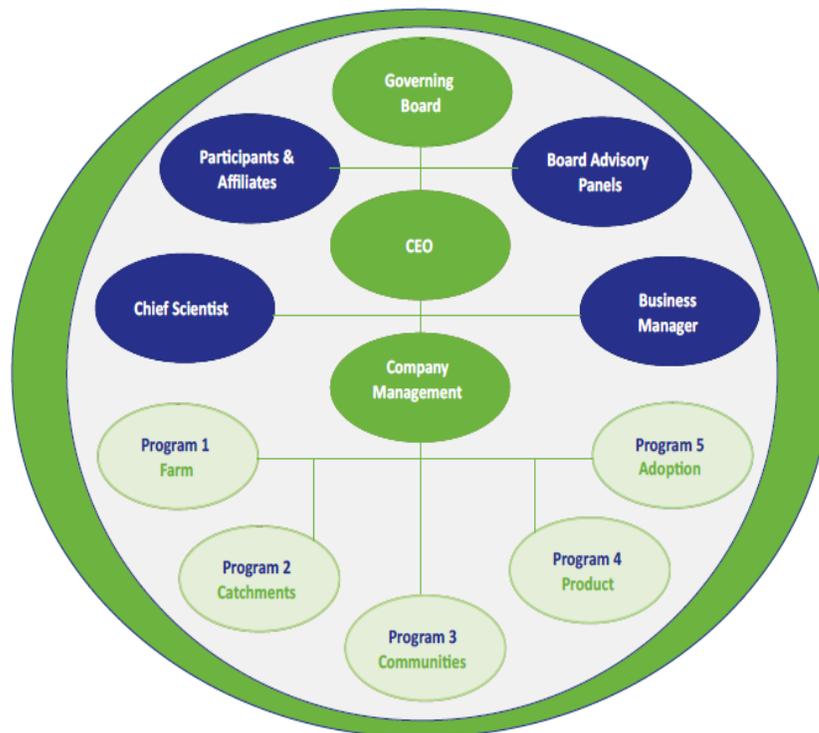


Figure 11: The management structure of the third Cotton CRC (2005–2012)
 (Source: Cotton Catchment Communities CRC 2011, p.12)

The most notable changes being an increase in centralisation of decision-making away from the partner organisations towards two key bodies within the central entity: the Board and the Centre Management.

Board composition

Centralisation has increased with a change in the composition of the governing Board. The Board is responsible for determining the strategic direction and overall investment profile of the CRC, by approving the annual business plans and budgets which operationalise the strategy outlined in the Participants Agreement:

We've got the participants' agreement which the participants signed on for and what they've made the commitment to. Then sitting below that then there's the strategic plan which is how are we going to do this and that was getting reviewed every year by the Board. (CRC Senior Manager)

In the first two CRCs, Board Members were chosen to represent the interests of contributing partner organisations; however, in the third CRC, regulation required for a majority of independent Board Members chosen for their skills and expertise. A new selection policy¹⁸⁰ ensured that while different groups of partners could nominate Board Members:

...they do not represent those groups at Board meetings. Rather, in accordance with Corporate Governance practice, they act and make decisions that are in the best interests of the Cotton CRC as a whole and which may or may not concur with the collective views of the group of members from which their nomination was derived (Cotton Catchment Communities CRC 2010, p.6).

The change in policy was perceived to increase the managerial expertise, reduce the influence of any single individual partner organisation:

¹⁸⁰ “The seven independent members and Chair were selected as: one person appointed in writing jointly by the Research Providers; one person appointed in writing jointly by the Industry Representatives; one person appointed in writing jointly by the Government Departments; and five persons elected by the members at a general meeting.” (Cotton Catchment Communities CRC 2010, p.6).

The previous CRCs were unincorporated joint ventures and they were horrendous because the Board Members sit around the table with their Board – there is this slice of cash, I want this portion of it and that's the argument that's had; whereas the skills based Board, they're all about making sure they hold me accountable for driving that outcome and enabling that to do so. (CRC Senior Manager)

Because there was a majority of independents, it did help. No one research provider could sort of push their way and overly exert pressure in the whole thing. (CRC Board Member)

As these quotes illustrate, the independence of the Board was perceived as a strength of latter CRCs, as it increased the emphasis on the CRC collective goals rather the interests of different stakeholders.

Internal management discretion

More discretion was also granted to the internal management, which slowly expanded from one dedicated staff member in the first CRC to 10–12 personnel in the third. The Company Management Team (CMT) was comprised of the CEO, the Chief Operations Officer (COO), Program Leaders, Chief Scientist, Business Manager, Project Management Officer, Accountant and Communications Manager. Whereas in earlier CRCs most operational decisions were made by the Board, in the third CRC these were delegated to the CEO, the Program Leaders or the CMT:

This is what the CRC could achieve quite nimbly because the Chief Executive is empowered to make those decisions and he was making those decisions based on the strategy which was signed off by the Board. Does this fit against that strategy? Yes or no. Rather than having to sell it to the Board. (CRC Senior Manager)

Thus within the Cotton CRC there was a high level of discretion given to internal managers to make decisions, which appeared to provide additional flexibility in operationalizing the strategic plan.

7.4. Operational planning and investment decisions

The scope of project-level investment decisions are, to a large degree, already planned in the bid application and Agreements before the CRC commences operation; however, a remaining concern is how to ensure that projects are developed in accordance with these plans. As industry end-users and government funders are not directly involved in project-level design or investment decisions, there is a risk that partners, who have a high degree of autonomy in developing projects, may initiate operational research activities that do not align with the contracted CRC's strategic outcomes. For example, CRC Managers acknowledged the institutional pressures faced by many scientists or academics, and anticipated a risk that providers would design projects that use CRC resources to satisfy alternative outcomes, such as generating scientific publications:

So it's tricky for the researchers because they've got two masters in that the universities are going, you just have to bang out good quality journal articles the whole time or books. And we're saying, we have to turn this into something that a grower can pick up all of it, someone down the street can read and apply, because that's how we get the outcome that we signed up for by people using the research to go and make a change. So it puts researchers in a pretty difficult situation. (CRC Senior Manager)

It generally falls to the CRC's internal management, particularly the Program Leaders, to ensure projects are designed in accordance with the CRC's objectives:

The main thing we did was engage researchers with their end user at the beginning, during and at the end. Most of our effort went into that. ...If you don't get it right at the beginning, you're going to get to the end and go, far out, we've got this dog of a project that delivered something that doesn't relate to anything. We can't apply it, we can't get people to use it... A lot of it was about managing researchers being able to think about how to apply their research. (CRC Program Leader)

Thus, a substantial amount of managers' efforts are directed towards influencing the direction of a project in the initial set-up stages, in which they rely on a combination of standardised processes and relational approaches.

7.4.1. Standardised project-setup procedures

All projects are subject to a similar set of project management processes throughout their life-cycle¹⁸¹(see Figure 12). There are several opportunities for managers to influence the nature of a CRC-funded project during a project’s initiation, evaluation and selection by the internal management team.

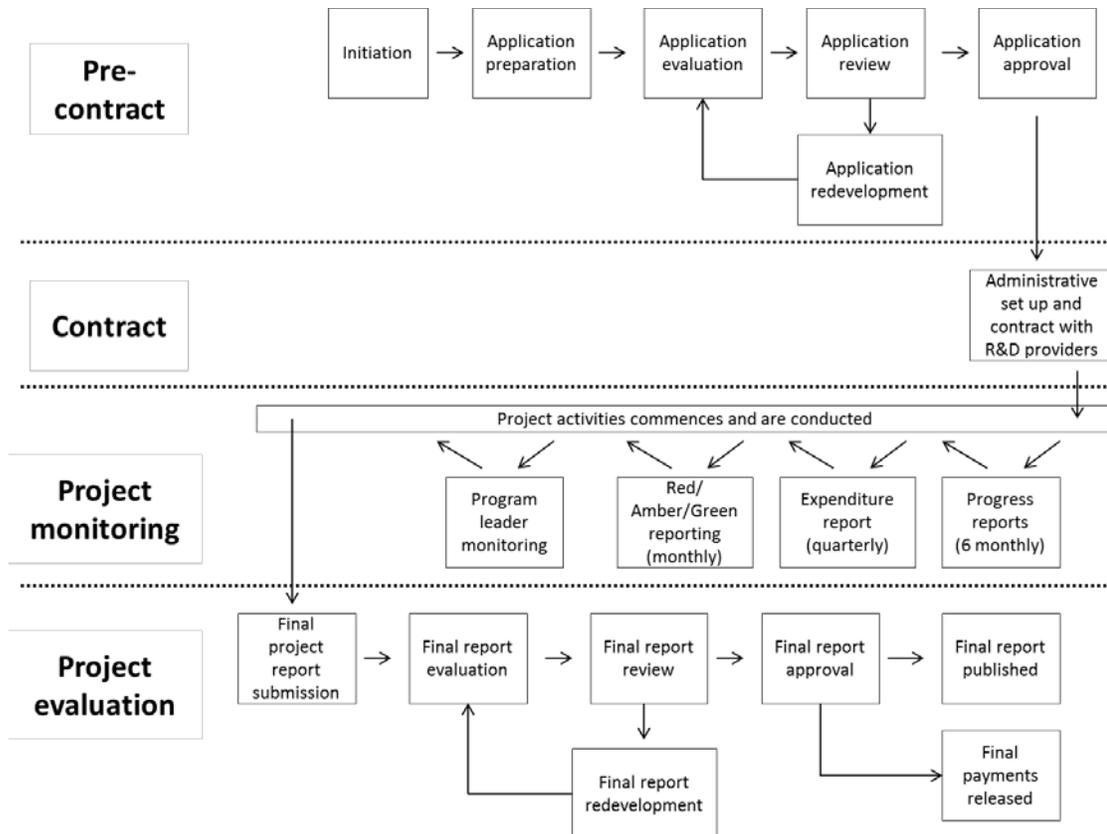


Figure 12: Project management at CRC

Project initiation

There are several channels through which CRC projects are initiated, which vary in the amount of discretion providers have in designing projects. The channel which gives providers the greatest scope is when the CRC ‘makes a call’ for research, by advertising on

¹⁸¹ While the R&D projects at the CRC vary, most generally progress through a similar set of processes across their life-cycle. These processes are relatively standardised and are formalised in process maps in the CRC’s operating procedures, with clear roles and responsibilities assigned to the individuals involved.

the CRC website and notifying participant and affiliate research organisations. A call for research typically outlines the parameters and eligibility criteria that applications need to fulfil, such as the maximum project length, amount of funding available, and the relevant strategic objectives.¹⁸² Calls vary in their scope from broad open calls to more narrow calls about specific research areas.

The second way projects are initiated is through the contractual commitments specified in the Participants' Agreement. Provider-partners may already be bound to conduct projects listed in 'Initial projects' (designed during the bid application process), or alternatively, may have committed to in-kind contributions that are later allocated to projects:

So you don't have to ever deal with organisations bickering and that sort of stuff. It's down to the detail of how much funds each organisation will contribute each year and how much in kind they'll contribute. So when you're putting projects together, you can definitely go and ask for certain levels of in kind or more involvement in a project because that's what that organisation sort of said that they would do... So you don't have to constantly just go and do that negotiation all the time and beat them around the head. Say, please, please, please will you do this sort of thing. (CRC Senior Manager)

For example, the CRDC is contracted to provide \$4 million worth of 'research' each year, which they fulfil through CRDC-funded projects¹⁸³ selected to meet CRC milestones. Alternatively when tied contributions have been made by non-providers, the Program Leader will liaise with the partner to determine "what it is that they need and where they would like their portion of the funds to go towards" (CRC Senior Manager).

The channel in which Program Leaders exert the most influence over design is when they commission particular individuals or research organisations to conduct specific projects. Whereas in open calls the project design generally emerges from ideas from the research providers, in commissioned projects the CRC approaches providers directly. This channel

¹⁸² A general requirement that for applications initiated through calls is that researchers be members of a participant or affiliate organisation.

¹⁸³ These are selected through the CRDCs own research proposal evaluation process detailed in Chapter 5. Most are oriented towards production-based research.

is used when others have not generated projects that address a tied contribution's requirements, or alternatively when a strategic milestone remains outstanding. These are identified by Program Leaders through 'gap analysis' of their research programs:

The Program Leader is responsible for making sure all the milestones in the program are achieved. So you'll have – I don't know – 50 odd milestones or something, you have to make sure you've got projects in there that specifically address those milestones. (CRC Senior Manager)

Ideally the commissioned R&D provider is a CRC partner; however, in some cases, consultants or third parties are used:

We also used consultants ... We try not to because we try and use our participants who signed up for it. But we just, in some instances, couldn't find any researchers in those organisations who could give us what we needed. (CRC Program Leader)

The use of initiation channels varied across the lifecycle of the CRCs, with an emphasis on open calls early in the operation, shifting to use of the more direct negotiation with participants, narrower open call, or commissioned research towards the end of the CRC term. Whereas early in its term, the CRC had substantial resources, the open call is effective in initiating a large number of diverse projects, accessing emergent or unexpected research ideas, and providing a sense of equity:

When the CRC started out and we had both more money and a range of people that we had to keep happy. Then what we tended to do was have open calls for projects. (CRC Program Leader)

As the CRC matured, the benefits of the open call diminished as there were fewer resources available, and less time to consider large numbers of research proposals. There also was a need for targeted approaches that could more efficiently find projects to address a specific list of unaddressed outcomes:

As you get towards the end of the CRC... you've got this long list of milestones ... you start to look at that and you say, gee, there's one that nothing's been done about, who can do

some work on that? That comes to be more and more important as you get towards the end of the CRC. You see where your gaps are and you commission projects to fill those gaps.
(CRC Program Leader)

In addition, as the CRC matured the Program Leaders tended to develop projects with providers with whom they had developed relationships with, and who had also developed ties with other partners in the CRC network:

I think the researchers have had a lot of input into the development of the projects themselves ...There's a connection between the Program Leader and the researchers themselves, and it's more of a collective building up of project concepts; and there's a connection with what the industry is needing or the community is needing. So that's a sort of collaboration and then you put things around those projects like regular steering committees or field days, or community meetings or conferences or whatever, which constantly feed back into that from the end user's need and that makes the project a bit more adaptive and relevant. But there's more buy in by the end users. (CRC Senior Manager)

Regardless of the initiation channel, all potential R&D projects were planned according to a standardised project application template, which included information such as a project overview; a detailed project plan¹⁸⁴; intellectual property and commercialisation considerations; and a detailed annual budget of contributions and expenditures. This provided a very detailed plan of a project's expected inputs, processes and outputs, which formed the basis of the final research contract and its ex post monitoring.

Project evaluation and selection

Project applications are then scored and evaluated by the relevant Program Leader, as well as two other members of the CMT, according to a standard set of criteria concerning the

¹⁸⁴ The project plan included background, aims and methodology; specific list of objectives, milestones, performance indicators, dates and risk assessment; a list of research questions, related previous work, expected outputs, science outcomes and industry outcomes; the significance of the research for end users, cotton industry, community, CRC/CRDC and BMP (Best Management Practices); strategy for adoption of research outputs.

likely feasibility of the project plan and the value of the outcomes generated.¹⁸⁵ These evaluations are reviewed by the entire CMT, who collectively make the recommendation for each project:

That's the critical thing, you've got the subject matter expert being a Program Leader who's got the expertise in that area. But you've got the entire CMT looking at the same thing from different directions as to how it fits into the broadest context of that billion dollars of value to the industry at the end of the day. (CRC Senior Manager)

The possible outcomes from the project review include: approval, rejection or modification of the project before another round of evaluation. For example, the CMT may recommend redeveloping a project to align to a different CRC milestone, or directing the project participants to work collaboratively with another research organisation in a similar project area.

Once a project application is approved by the CMT, the central administrative staff facilitate the administrative set up of the project, which involves drafting a formal R&D project contract for each of the organisations, and working with administrators in partner organisations to formalise the agreement:

The relationships that [the administrative staff] have got with those people in there means that we can get stuff signed, so projects can get underway. (CRC Senior Manager)

Based upon the accounts from both CRC managers and providers, the routines embedded with the standardised project set-up processes appear to work relatively effectively. However, the effectiveness of the project management, appears to be contingent on the nature of the relations and prior experience with the particular provider that is contracted.

¹⁸⁵ Each project is evaluated according to 10 different categories, including: fit to industry and/or community needs; fit to the CRC Strategic Plan; science excellence; potential for innovation; communication and extension; budget and leverage of funds; pathway to adoption; collaboration; linkages; timelines and project establishment risk. Ratings involve assigning a quantitative score (out of 10 for each category, giving a total project score out of 100), and qualitative comment for each category. The evaluations conducted by each individual are aggregated into summary assessment sheet, which collates the score, by category and total, by each individual and the all comments.

7.4.2. Relational mechanisms

The significance of relational ties in project set-up was made apparent in contrasting accounts about the Cotton CRC's interaction with different research providers. The majority of CRC projects are conducted by contributing partner-providers, who are bound by the terms of the Participants Agreement to collaborate towards the collective goals of the CRC, to commit specified resources over the 7-year lifespan, and to execute certain projects to address the CRC's agreed outcomes. Some of these organisations have been involved in the Cotton CRC since its inception, with some of their employees performing administrative roles within the CRC as members of the internal management structure, representatives on the governing Board, or on advisory committees.

Typically partner-providers have delivered projects in the production-related research programs. Because of the long-running involvement of these individuals and organisations, a 'culture' had developed around how production projects were run:

There's a real culture in the production style of research now. You see it with the DPI and the CSIRO researchers; particularly say with entomologists who might be based with CSIRO and with the guys in Queensland in DAF there. Someone in DAF up there will run a field day and invite the researchers from here to come up; they're the ones with the skills and they're able to do that because there's money in their projects for that sort of thing to happen. (CRC Senior Manager)

At the end of the day, many a conversation is had behind shut doors and so, look, it's about the research. Let's not have the tail wagging the dog here...(CRC Senior Manager)

However, the scope of the second and third CRCs expanded to a broad range of research programs – such as the environmental and communities programs – which lay outside the expertise of the partner-providers. To achieve its mandated outcomes in these areas the CRC was forced to contract with third party consultants, individuals or organisations. These providers were not party to the CRC's Agreements, were generally located in metropolitan cities rather than cotton growing regions, had little experience in agricultural

R&D or the cotton industry, and were typically involved in the delivery of only one-off projects:

I think, from a production perspective, we've had such a long time that the researchers ... they know the work now.... But social science is still so new that you need another 10 years of cultivating those relationships.... (CRC Senior Manager)

The lack of relational ties between the CRC and these third party providers created several challenges in using the standardised project-set processes. For example, as the standard channels of initiating projects generally required the CRC to have pre-existing relations with or knowledge of potential suppliers, the CRC struggled to find or locate suitable providers in the new programs:

It was really hard to try and find people; so the communities program, the social research, was really slow to get going because we went down the typical avenues of putting calls out for projects and we were just getting stuff that you just thought, 'you guys haven't been out of your office in Sydney, you don't know anything about the industry, you're not connected to anyone in the bush and you've got this real metropolitan view of an industry and the bush'. (CRC Senior Manager)

But we still had to develop up and bring new people into the CRC environmental research. And the social research, there'd been no connection whatsoever; so we had to just start new partnerships and try and find researchers who were going to be able to [deliver] – who'd got what the CRC was about. (CRC Senior Manager)

Second, as these prospective researchers had little prior interaction with the CRC, they lacked the experiential know-how about the nature or style of R&D projects that were required by the Cotton CRC:

Over the life of this CRC, we've had people ... working in a CRC for the last 18 years and just get it and that's just the way they operate through to the – 'we've got no idea about the industry or CRC or even rural Australia and so now we want to do rural research because there's some money on the table'. And so it has just been this real diversity. (CRC Senior Manager)

The lack of knowledge or experience about rural concerns or interests also limited the effectiveness of initiating projects through open calls, as providers were unable to design projects that met funders' expectations:

In the end, we went about actually trying to commission research. Because we put out a call and said we want projects to do X, Y and Z and meet these milestones and we just got stuff in we couldn't do. So in the end we turned it around and I ended up writing a whole lot of tender documents to say, I want a project that will do this, this, this and this and it's got to have these outcomes and it's got to have this sort of extension or connection to the community built into it and that sort of thing. (CRC Program Leader)

While commissioning research gave a clearer guide to prospective applicants about funders' needs and requirements, Program Leaders still faced the challenge of locating individuals who could fulfil these obligations. This was further complicated, at least initially, by managers' lack of expertise and appreciation about the nature of work in environmental or social science-based disciplines. As a result, it was difficult for Program Leaders to justify investing in projects within the new programs, which was evident in their own concerns about being able to rationalise the value of projects in terms of the relevance to broader industry stakeholders:

And for industry, because this is the first time industry have ever funded a social research project, they were looking at these applications not knowing. (CRC Program Leader)

The other thing about social researchers is their audience is not necessarily educated. So the gap between end user and the academic in the social realm is massive. (CRC Program Leader)

Third, because third party providers were not bound to the CRC Agreements or embedded within the broader cotton R&D network, there was a perception that they were more likely to behave opportunistically:

That's right, and we've definitely seen that in the communities program and we joke about seagull researchers in the program, which you sort of have to be careful about. But they come in from out of bigger places, they shit everywhere and they fly back out again... these

guys make the mess and get the hell back out of there and write an academic paper from afar. (CRC Program Leader)

Finally, it also became a lot more difficult to set-up the administrative component of research contracts. If the R&D provider already is a participant of the CRC (which is the case for the majority of the CRC's projects) then this process is relatively simple – having signed the Participants Agreement, the new R&D project contract represents an additional one-page schedule of activities relating to that specific project. If however, the R&D providers are non-CRC participants, then an entire research project agreement is required, which outlines not only the terms of the exchange but also the legal details of being funded by the CRC.

Due to these difficulties with initiating and investing in suitable projects within the environment and social research programs, half way through the term of the third CRC, two full-time dedicated Program Leaders were appointed. Both individuals worked intensively to identify, recruit, mentor and build relations with new providers for their programs, over the course of several years:

It's only been in the last few years, after we've had a bit of trial and error with who can we work with and what sorts of ideas [come up], that we've started to get projects that are starting to be applied social research in a way. So that's been a real education of the researchers. (CRC Program Leader)

Therefore, in these programs, even though the Cotton CRC initially was forced to contract with new non-partner providers, through careful screening and socialisation efforts, program managers have been able to develop some regularity in contracting with providers who understood the Cotton CRC's requirements for projects.

7.5. Management, monitoring and reporting of R&D activities

Once the operational activities of the CRC were under way, most of the managerial effort focused on ensuring that the CRC delivered its contractual outcomes. In this context, there appeared to be three related concerns: that outcomes from R&D activities actually complied

with the specified outcomes in the Agreements; that outcomes were delivered within the time frame of the limited life of the CRC entity; and, that outcomes were achieved within the constraints of the budget. Management control was exercised to monitor the activities and outputs of individual projects as well as the entire entity.

7.5.1. Project-level monitoring and management

At a project-level, the focus of control was ensuring projects achieved the milestones, outputs and budget constraints specified in the project contracts. The monitoring function was performed mainly by Program Leaders, who were held accountable for the delivery of projects, outcomes and milestones within their respective programs. When monitoring projects' progress, Program Leaders had to balance the need to ensure that project activities conformed to the in-process plans specified in the project agreement, against an appreciation that R&D projects entailed a degree of risk:

It's also high risk because if you knew what the outcome was at the outset, why would you undertake to understand [it] – so you need to allow for the risk that something is not going to happen. (CRC Senior Manager)

Projects encountered a range of unexpected problems, emerging either from the science or more operational issues, such as:

If it's a science perspective, it can be simple as this is what we thought we were going to do but now we found out that we can't do that, or the results are saying that's not what we expected. (CRC Program Leader)

You can have all sorts of things, students 'go AWOL', or people get pregnant, or all sorts of things, or people just not giving you the information that you need. (CRC Program Leader)

Someone's suddenly going off on maternity leave, is that going to be an issue, what's being done about it, that sort of stuff. We've had floods, what's the impact of that sort of stuff. (CRC Senior Manager)

While these types of emergent issues did not constitute any form of malice or negative intent by the provider, they reduced the ability of the provider to meet outcomes within the

constraints of the original contract, and thus needed to be identified and managed. In addition, managers needed to be able to differentiate these more benign contract deviations from situations when researchers had adjusted or modified the project to satisfy their own personal or institutional interests:

They've ultimately had to compromise what they wanted to do in the name of actually getting funding and then once they actually have their funding, they have just a natural inclination to migrate back to what they really wanted to do in the first instance. (CRC Senior Manager)

It's a hard balance between being too intrusive with the researchers and just letting them go. ... What I see is a researcher has a pet area of interest and they will look around for people to try and fund that. They will compromise and compromise and compromise until such time as they get somebody to fund it and then try and drag it back to where they really want to! (CRC Senior Manager)

To diagnose and manage emergent project variations, the internal management used a combination of standardised practices including progress reporting, expenditure controls, management by exception monitoring, and project termination decisions, and as well as more personal direct supervision.

Progress reporting

Every six months all providers were required to submit standardised progress reports, which described their activities and outcomes in relation to the project's contractual aims and milestones, and reported expenses compared to budget. The reports were then reviewed by the relevant Program Leader, who, if need be, would follow up on any emergent issues by contacting the researchers directly.

Controlling expenditure

The expenditure of projects was controlled through budgetary monitoring enforced by central administrative staff. Typically providers would absorb project expenses, and then would claim a reimbursement in their quarterly expenditure report. CRC staff would review the actual expenses compared to the project budget; only project costs that remained below

budget were paid. This reimbursement process was only recently changed from a previous system of cash advances, whereby the research providers would eventually repay any underspend. The administrators saw several benefits of the new policy including: it simplified the accounting process; it increased the liquid working capital resources; it provided a stronger incentive to providers for timely expenditure reporting; and it reduced the incentive for R&D providers to over-budget in project applications:

It was very interesting because I managed the [CRC2] and then this one. We spent so much time, like you'd pay a project out to budget and then they would come back and say, ... this is how much I've spent. I've got this much left over. ... It was quite amazing the effort that it took and ... at one point in time, I had \$1.2 million sitting out there in other people's bank accounts. (CRC Manager)

In addition, for projects experiencing problems, the CRC managers had the option of withholding payments until issues had been rectified:

If the Program Leader thinks there's a problem with a project, then we know to hold the quarterly payment for those two quarters. ...It gives us an opportunity to say, this project is not on track, this is falling over, we need to step in and see how we can assist, or do we close this project off. Or they can come back and say, look, this is a seasonal thing, we'll be back on track and it continues. (CRC Manager)

The project budgets were all systematically reviewed each quarter, with budget variances by project reported to the CMT and then the Board. These variances provided an indication about projects that were running close to their financial limit, and projects with little expenditure or activity.

Monthly management-by-exception monitoring

The progress and financial reporting also formed part of a more regular management-by-exception process by the CMT. It operated through the combination of a RAG (Red-Amber-Green) Report and the CMT monthly meeting, introduced by the CEO to track the progress of all open projects within the CRC portfolio. Prior to their meeting, each CMT member reviewed and updated the RAG report (an excel file listing open projects). If they

were aware of any problems with a project they could ‘RAG’ it, by changing its status from green to amber or red:

Green is, yep, it's all good. Amber, something's going on, we need to do something about it. Red, holy smoke, it's all gone – we've got to do something about this quick. (CRC Senior Manager)

All projects listed as amber and red were then discussed at the meeting, thus enabling the CMT to monitor the entire portfolio on a monthly basis:

It's beautiful, and that's how you manage monthly, your projects, by exception. (CRC Manager)

Any individual could ‘RAG’ a project, which meant that different people would ‘RAG’ for different reasons. For example:

So I would flag something, say amber or red, if I'd heard through the grapevine that the student hadn't shown up for the last six months or the supervisor wasn't talking to the student anymore or whatever the problem is. [The Project Management Officer] would RAG it because there might be some extension required and they haven't requested it, or no one signed the contract yet and the work has already started. Then [the Business Manager] would RAG it because no money has been spent or nothing has been paid out from our end or it's overspent and they're asking us for more money, that sort of thing. So we get a full picture about where the project is at. (CRC Program Leader)

This approach is both flexible, as there are no limits to the reason why a project may be ‘ragged’, as well as democratic, as any member of the CMT can raise a project for discussion. It also contributes to a shared sense of responsibility and generating a ‘blame free culture’ within the CMT. This was perceived as crucial for encouraging the early detection of problems that enabled timely managerial responses before project deadlines fell due:

If things are going pear shaped, let us know early on and then it's everybody's responsibility ...[We] didn't want anything to go from green to red ...to really encourage the amber

reporting. If anybody hits red reporting and it's because they've been sitting on something and haven't told anybody, then I would get quite firm. But otherwise, okay, righto, it's turned to poo because somebody's – they've lost the data or something like that. It's not your fault. What are we going to do? (CRC Senior Manager)

The sense of joint responsibility was reinforced by the collective development of action plans for amber or red projects. These could range from continued close monitoring to more interventionist measures, such as renegotiation of milestone, outcomes, resourcing or personnel of a project:

As a group we discuss – or the person who flagged it red will lead the discussion of – why and then we as a group say what we should do. Should we just watch it or we should contact the researchers or the organisation. As a group, that decision is made because you've got people with all different skills sitting there looking at things differently and from different organisations. (CRC Manager)

It depends what it is that goes wrong with it and who needs to get involved in it. If it's a science perspective ...It can just be a matter of sitting down and renegotiating new milestones or providing an extension of time, if they need to. (CRC Program Leader)

Also, the RAG reporting process formalised internal managers' responsibilities, as the list of actions required were assigned to different CMT members. This list of managerial responsibilities was then reviewed at the following monthly meeting.

Project termination decisions

If a project suffered from recurrent problems, then the CMT reserved the right to terminate it. When projects failed to meet their milestones, managers spoke of the need to understand the underlying issue, to learn from it, to work with providers to solve issues or reorient the aims of projects. However, if problems continued to persist, there had been occasions when the CRC had decided to stop the project from proceeding. As a result of the limited time period the CRC had to operate within, the CMT adopted a 'fail fast' culture:

If something fails, fail fast, move on. Learn from it. Okay, just move on. (CRC Senior Manager)

Program Leader direct supervision

Outside the standardised monitoring processes, projects were also managed through the informal supervision of the Program Leaders. At any given point in time, each Program Leader would be monitoring between 20–40 open projects within their own program; of which one or two might require closer supervision. Program Leaders would maintain regular personal contact with researchers, following up on progress reports or more intermittently, which allow them to monitor and intervene on a timely, informal basis:

The Program Leaders were across the research, they'd pick up the phone, they're on the lookout for what's going on, they're continually talking to the researchers. If things are just happening [progressing], then there's a green flag for the month because they're travelling along... (CRC Manager)

Although there's got to be a formal report on each progress report – a lot of [follow-up] is done informal[ly] – ring them up on the phone and say, hey, I just read your latest progress report, that's interesting, tell us a bit more about that or perhaps give them a bit of feedback. (CRC Program Leader)

This form of 'active management' also enabled the leaders to obtain and maintain a working knowledge of the science involved in the projects in their area. Having regular interactions between researchers and managers with scientific expertise was considered to be crucial in ensuring that problems were identified and proactively managed:

You need someone that understands the science to know what the outputs are and where they might be going off track. Where they might need some help. Not micro managing... But just trying to drive the thing to keep on track because that's one of the biggest issues ...You can't always keep a research project on ...People come and report that early and actively to try and find a way just to make sure that your outcomes will still be within a period of time. Scientists are really bad at coming and saying, I'm not going to be able to meet this milestone. They come afterwards when you chase them and say, your milestone was due six months ago, why hasn't it been done. Well, we had a drought and pests and insects and you sort of say, well, what are you doing about getting it on track? Oh well, we're going to have to go a bit further. Then you say, well, how are you going to pay for that if you need

another six months, how are you going to pay for it because we're not. So you kind of get all that sort of stuff that needs someone really on the ball. (CRC Board Member)

More direct personal supervision of projects was considerably easier for the Program Leaders of the production research programs, who were senior cotton researchers already employed by provider organisations¹⁸⁶, many of whom were physically co-located within the same research facility as the CRC. One of the difficulties of the community and environmental research programs was that the Program Leaders needed to interact with providers that were not physically or socially embedded within the cotton R&D community. Therefore, they often were required to travel frequently in order to interact with providers in their program.

Final project compliance and dissemination

As projects drew to a close, the CRC managers' attention focused on ensuring that the outputs from research activities complied with the contractual outcomes. Providers submitted their final report of their research, which was then reviewed, evaluated and ultimately approved by the Program Leader and CMT, before the Business Manager released the final expenditure reimbursement to the provider.

As most projects outcomes required some form of feedback to end-users (e.g. publication on CRC website, newsletter), one issue that arose at this stage was the varying ability of researchers, particularly those embedded within institutions, to be able to 'speak back' to growers about the outcomes from their research:

...the universities are going, 'you just have to bang out good quality journal articles the whole time or books and all that sort of stuff'. And we're saying, 'we have to turn this into something that a grower can pick up all of it, someone down the street can read and apply' because that's how we get the outcome that we signed up for by people using the research to go and make a change. (CRC Program Leader)

¹⁸⁶ However, this did create complex accountability situations, where in-kind Program Leaders remained accountable to their employer as well as the CRC.

Yeah, and that's the real difficulty, particularly for researchers I suppose, is that you're trained in a writing style of science and then to flip between that and growers is not easy.
(CRC Program Leader)

This issue was more pronounced for providers, such as remote researchers, new partners or third parties, who were not as embedded within the relational cotton R&D. With limited experience or proximity to cotton, they experienced difficulty in translating their work into the types of outputs that were perceived as useful by the broader industry stakeholders:

We really struggled with remote researchers, making sure that their conception models were real, that they had a realistic idea of what was going to be a useful output, and what was a useful way of framing their question. Because it can all get a bit academic. (CRC Program Leader)

I've been to R&D workshops... I'm the devil because I'm saying, no one on the ground understands what this is for, no one understands what you're trying to achieve, we can't see how you're going to monitor it...Because they're not connected to the landholder and they're totally not connected to the local community. (CRC Program Leader)

To assist these researchers the CRC hired a dedicated Communications Officer, who provided guidance and suggestions about how researchers could frame their results. This was not just from a technical point of view but also to ensure sensitive issues are expressed in a way that means the broader community remains receptive.

The CRC also tried to facilitate relation-building within the CRC's network of organisations by hosting conferences, forums and workshops. These provided researchers with an opportunity to interact and collaborate with other providers, and to build a sense of community amongst the CRC participants:

It gives them that sense of community, belonging to something in the greater picture, which then validates their want to be able to share, interact and learn from others. (CRC Senior Manager)

In addition, these forums were also used to connect researchers with end-users. This was thought to overcome some of the information differences by developing better tacit understandings by CRC researchers of how their research projects could address the needs of growers and community groups:

The researcher we work with had a workshop really recently where she broadened out the workshop attendees. There was millions of emails after that workshop saying, finally, that's the most productive workshop. Because, all of a sudden – this was the real beauty of the CRC – is that all these people came together for a common goal in a way that was not adversarial. It wasn't policy and planning, so they weren't these hideous decisions having to be made. It was all about the science and how can we better understand this – science is something you can agree on, that's fairly rigorous, and if it's done properly, you can agree on the outcomes. (CRC Program Leader)

As this example illustrates, these conferences appeared to create a social forum that enabled the development of shared sets of understandings between different parties, which ultimately allowed for more close alignment of their interests.

7.5.2. Centre-level monitoring and reporting

At the Centre level, the delivery of outcomes focused on ensuring that the CRC entity as a whole met its contracted obligations specified in the Agreements. This was accomplished through a detailed chain of accountabilities (see Table 13), between research providers, the CMT, the Board and the contributing partner organisations. Various forms of monitoring and reporting occurred between these different organisational levels, during its operation and at its wind-up.

Table 13: Accountability structure of the Cotton CRC

Body/Individual	Who	Responsibility	Accountability (to)
DIISR (The Department of Innovation, Industry, Science and Research)	Minister in charge of the CRC Program	Monitoring and ensuring that the CRC meets its prescribed objectives	Parliament
Centre Forum	Representatives from participants and affiliates	Monitoring Centre's progress; providing advice to the Board	Participants and affiliates
Governing Board	Independent directors and chair	Setting the policy and strategic direction of the CRC, monitoring its overall performance towards agreed outputs and outcomes, and maintaining the operating values and principles set by the members	Commonwealth Government (DIISR); Centre Forum
CEO	Individual	Leading the CRC, ensuring that it achieves or exceeds its objectives, optimises use of its resources, and meets statutory and contractual obligations	Board
Chief Operating Officer (COO)	Individual	Supporting the CEO and overseeing the delivery of all Cotton CRC outcomes and milestones	CEO
Company Management Team (CMT)	CEO, COO, Chief Scientist, Business Manager, Program Leaders	The operational management of the CRC	Board
Chief Scientist	Individual	Providing overall scientific leadership at the CRC	CMT, CEO, Board
Program Leaders	Senior researchers	Selecting, monitoring and managing the projects conducted within their research program	CMT, CEO and Board
Business Manager/Project Management Officer/Accountant	Administrative staff	Ensuring the CRC is compliant with its statutory, contractual, legal, corporate governance and financial obligations	CEO
Project Leaders	Researchers	Conducting and managing the projects funded by the CRC	Program Leaders and CMT

Board and internal management monitoring

During its term, the Board maintained oversight over operational decisions and outcomes by monitoring the internal managers, who reported to the Board meetings on a regular basis:

So we [the Board] wanted reporting on progress, so we didn't want any sort of surprises so just keep us up to date on how projects are going. (CRC Board Member)

One of the key reasons management of the CRC was considered effective (Cotton Catchment Communities CRC 2012b) was a clear demarcation between the strategic role of the Board and operational management by CMT:

They [CMT] then had to work to that, so that's been their key role and they've been very focused on the outcomes. So we need to make sure we're going to deliver on all of the outcomes. Well, we only have one employee which is the CEO, as far as the Board is really concerned. (CRC Board Member)

Well, the Board are not across the projects. They're across problem projects. They're more keen at keeping track of the strategy of how are we going to get this specific outcome? Then they hold the Chief Executive, who is the only employee of the Board, accountable to achieve those. So this is why you've got to have a reporting process. That is quite different to a lot of organisations. It's actually a very commercial sort of approach. The directors do the direction and management do the management and the connection with that is through the Chief Executive. (CRC Senior Manager)

As these interviewees describe, the monitoring of the Board was simplified by holding the CEO accountable for internal management. Although Program Leaders and the CEO were all members of the CMT, which emphasised shared decision-making and collective responsibility, there still existed a hierarchical relation in terms of delivering outcomes, whereby the Program Leaders were accountable for the delivery of their programs to the CEO, and the CEO was accountable for the delivery of the entire Centre's performance to the Board. In this capacity the CEO described their own role as being an 'enabler', who could 'trouble shoot' operational issues, while also working with the Board to ensure the delivery and reporting of the strategy.

The CEO was supported by the chief operating officer (COO) – a position created in the third CRC to assist the CEO in overseeing the operational delivery of all Cotton CRC

outcomes and milestones. In coordination with the CEO, the COO developed and implemented the CRC's monitoring and evaluation program (M&E):

From the CRC's perspective we have an agreement with the Commonwealth and the participants, all 11 participants, that says we will improve water use efficiency by 50 per cent, we will improve groundwater modelling by 10 per cent, we will increase the uptake of integrated pest management by 50 per cent. So that's the goal. Now the question is how the hell we get at it. DPI, UNE [University of New England], CSIRO, you need to work on a project together to drive that outcome. So that's the question we've always asked the management team here, is how we're tracking at these goals. (CRC Senior Manager)

By developing this M&E system, the Cotton CRC's senior managers were able to use highly specific key performance indicators as a means to measure the operational activities of all CRC and project outcomes, and thus monitor and manage the arrangements' progress towards achieving its contractual obligations within its term.

Partner monitoring and reporting

The Board was then held accountable by government and participating organisations through several different forms of monitoring, reporting and evaluation during its term. Less intrusive monitoring occurred through the 'Centre Forum' – a representative body comprised of delegates from participants and affiliates – which assembled at least every six months to review the CRC's progress and provide non-binding recommendations to the Board. This was supplemented, at times by specialist advisory panels (e.g. Science/Education, Technology and End User, and Catchment and Community), which although chaired by Board Members, were comprised of participants, affiliates and relevant experts, to provide advice on specific issues, such as research/utilisation opportunities, resource allocation, emerging technical issues, opportunities for commercialisation and collaboration.

More formal reporting requirements included the provision of quarterly financial¹⁸⁷ and annual reports to government and participating organisations. The annual report, which was prepared primarily by internal staff, contained information about: investment decisions; progress according to the strategic and operational plans; the expected achievement of material milestones or objectives; the progress on R&D activities according to the milestones and outcomes set out in the schedule of activities; and the commercialisation of any IP.

In addition, the CRC was also subject to two external reviews during its term (at year 3 and year 5), to evaluate the progress of the Centre in meeting its milestones, and to make recommendations about what adjustments were deemed necessary to ensure the CRC would meet its contractual objectives. These reviews were conducted by an external panel, who over the course of several months, would review operations, and provide interim reports and final reports to which the Board prepared a formal response. Some recommendations led to changes in the CRC, such as a reorganisation of the research program structure, the hiring of additional dedicated managerial personnel, and the introduction of the formal Monitoring and Evaluation (M&E) program.

Managing the 'wind-up'

In the final year, the monitoring and management of the CRC intensified as it approached the end of its term. This in part was because, due to its limited life, managers need to balance the completion of still uncertain activities required to achieve the objectives, while also ensuring that all resources, particularly the financial reserves were used by the end date:

You manage the organisation down to nothing. (CRC Senior Manager)

Also as the CRC approached wind-up the managers and Board needed to demonstrate compliance with the Agreements. This was accomplished through the preparation of the final annual report which attests to the completion of activities and outlines how all the

¹⁸⁷ This described the income, expenditure, assets, liabilities and cash position of the CRC.

strategic objectives have been met. Furthermore, as the third Cotton CRC represented an end to CRC arrangements within the cotton industry, the annual report was also published as part of an 'exit book' that described the contributions of the three CRCs over the entire 18 year period (see Cotton Catchment Communities CRC 2012b).

The achievement of the Cotton CRC objectives was also verified through an economic evaluation conducted by external consultants (Vere & Scott 2012). The consultants calculated estimates of the economic value of the potential benefits of the Cotton CRC's five scientific programs as well as the entity as a whole. The report concluded that:

...the research conducted by the Cotton CRC has the potential to generate significant economic benefits to the Australian cotton industry, largely by raising industry productivity through the generation of faster rates of and higher levels of new technology adoption. (Vere & Scott 2012, p.48)

More specifically, the evaluation estimated that the Cotton CRC entity generated an incremental benefit of nearly \$1.1 billion (net present value). The Cotton CRC managers used this as evidence that the entity generated an economic return that exceeded the targets specified in the original bid application.

7.6. Chapter Summary

In this chapter I have presented the case description of the three successive Cotton CRCs, which have been operating continuously since 1993. The Cotton CRC arrangements each combined government funding with cash, in-kind and capital contributions from a range of research organisations, government agencies, universities and commercial firms to conduct a series of R&D projects that achieve a set of collective outcomes within seven year time periods. This description shows that much of the management of the Cotton CRC was determined in the set-up of each arrangement (described in Section 7.3), such as in the preparation of the bid application, the development of long-term contractual Agreements between contributing parties, and the creation of a central entity to ensure the Agreements were operationalised. During its operation the Cotton CRC then operated through the collective decision-making of an internal management team who used standardised project

management techniques to organise R&D projects to fulfil the CRC goals (described in section 7.4). Due to its limited life there was substantial pressure to ensure the contractual objectives were achieved. As described in Section 7.5, this was accomplished through extensive use of several project-level and centre-level reporting mechanisms.

Chapter 8: Cross-case comparisons

8.1. Introduction

The aim of this chapter is to present the cross-case analysis of the two case studies – the CRDC and the Cotton CRC – described in the previous two chapters. By comparing these two cases, I aim to establish an understanding of the overarching architecture of the two inter-organisational arrangements. In Section 8.2, my analysis focuses on identifying the substantive differences between the two inter-organisational arrangements. This takes the form of a simple comparison of the similarities and differences between the two cases, in terms of their operating context, hybrid structures and MCS. This is followed in Section 8.3 by an analysis of the between-case variation in the more general configurations of control solutions. This analysis reveals patterns – consistent with an archetypal approach – that hybrid structures and embedded MCS combine to form distinct, internally congruent combinations of control solutions.

8.2. Reflecting on the nature of the two hybrid arrangements

The Cotton CRC and the CRDC are two alternative inter-organisational arrangements operating in the Australian cotton industry, which both facilitate the investment of collective funds into R&D projects conducted by multiple research providers. In this section I compare the nature and general operation of these two arrangements, by examining their similarities and differences in terms of their operating context, hybrid governance structure, and embedded MCS. Based on these simple comparisons, I then present evidence of hybrid-MCS archetypal patterns. By studying the linkages between hybrid structural characteristics and MCS I show how each hybrid form encompasses a distinct, internally congruent combination of control solutions.

8.2.1. Comparing the operating context

There are several similarities in the operating context of the CRDC and Cotton CRC. Both have been operating over a similar time span, within the same industry and are headquartered within the same regional location. Both were initiated by federally funded government programs, with similar mandates to invest in R&D projects that will benefit the

cotton industry. Both operate by concurrently funding a number of short-term projects and making the resulting outcomes publically available to grower and community end users.

There are also similarities in the composition of their R&D portfolios. Since their inception, both have invested in production-related research¹⁸⁸, which has often been conducted by the same pool of cotton-specialist research organisations. Over time, both entities have diversified their research programs, supplementing production focused research with environmental, economic and social science research. To deliver these different areas of research both organisations have contracted with a broader range of research providers who do not necessarily have prior experience in cotton R&D.

The most significant difference in their operating contexts concerns the uncertainty in resource availability. The Cotton CRC has relatively low uncertainty in resource provision throughout its 7-year life span as a result of the binding contractual obligations signed by partners before the commencement of its operation. The amount of funds available for the CRDC through the levy structure varies with annual cotton production, depending on a range of factors outside the CRDC's control, such as the availability of water and level of cotton production.

8.2.2. Comparing the hybrid structures

Despite similarities in their operating context, the two cases represent different types of hybrid governance. The CRDC represents a subcontracting arrangement (Ménard 2013), where the central entity acts as an intermediary that awards R&D project funding to competing external providers on behalf of its two funding constituents. The Cotton CRC, as a joint venture and later a company limited by guarantee, is an equity-based alliance (Ménard 2013; Oxley 1997). Contributing partners provide cash and in-kind resources to the arrangement, which administers projects conducted by partner providers or non-partner research contractors.

¹⁸⁸ Part of the overlap stems from a mechanical relation in a subset of transactions, where the CRDC funds a series of projects, administered through the CRC. However, even when these transactions are excluded, there still remains a high degree of overlap in the composition of their portfolios.

The cases also differ in their expected lifespan. The CRDC is a perpetual arrangement, designed to continue indefinitely as a going concern; the Cotton CRC is a limited life entity. In the remainder of this section, I compare the two hybrids according to each of the structural dimensions (from Chapter 3). This is summarised in Table 14.

Table 14: Summary of hybrid features of two cases

	CRDC	Cotton CRC
<i>Type of hybrid</i>	Perpetual subcontracting arrangement	Limited life equity alliance
<i>Formalisation</i>	<i>Associational contracts:</i> PIERD Act; Deed; Constitution <i>Exchange contracts:</i> Standardised individual project contracts	<i>Associational contracts:</i> CRC Program Rules; Bid application, Cotton CRC Agreements Constitution <i>Exchange contracts:</i> Standardised individual project contracts; Initial project list
<i>Centralisation of property rights</i>	<i>High centralisation of assets and property rights:</i> Single collective investment pool from mandatory grower levies and matched government contributions	<i>Moderate centralisation of assets and property rights:</i> Collective investment pool funded by CRC grant from Commonwealth government and untied/tied contributions from partners
<i>Centralisation of investment decision rights</i>	<i>High centralisation</i> of R&D project investment decisions, made annually by CRDC Board of Directors	<i>Moderate centralisation</i> of R&D project investment decisions, where initial investment decisions made by contributing partners as part of bid application; residual investment decisions made by CMT
<i>Centralisation of coordination, monitoring and evaluation</i>	<i>Moderate centralisation of monitoring</i> by CRDC entity (Board of Directors, Program Managers); reliance on research provider organisations' for the operational control of R&D project activities	<i>High centralisation of monitoring and operational control</i> by CRC entity (Board of Directors, CMT, Program Leaders)
<i>Relational governance</i>	Vertical hierarchical demarcations between funders, CRDC entity and providers; relations completely mediated by the CRDC Close relational ties with grower representatives	Lateral collaborative network between all contributing partners Development of close relational ties between CRC entity and partners

Formalisation

The Cotton CRC and CRDC both rely on contractual formalisation to dictate how the arrangements operate and the terms of transferring funding for R&D outcomes. They rely on a similar set of contractual mechanisms at associational and exchange levels (Grandori & Soda 1995), including government legislation, regulation and rules, associational-agreements, and standardised project-level contracts.

The arrangements' formalisation varies in terms of which parties are bound to the contractual agreements. In the CRDC, funders and providers are bound to different types of contracts. The perpetual relations with funders are governed by the PIERD legislation, which outlines the terms of the funder contributions, as well as the general operation of the CRDC structure. The CRDC uses short-term project agreements with its providers, with little broader association-level formalisation.¹⁸⁹ In the Cotton CRC, the nature of formalisation does not vary by the type of exchange party, but by the level of participation in the arrangement. All contributing partners are bound by the same formalisation mechanisms – the Participants Agreement, Commonwealth Agreement and CRC Program Rules – regardless of whether they are commercial organisations, government or R&D providers. These agreements bound partner organisations to both associational and exchange terms. In comparison, non-partner parties, such as affiliates or third party contracts, are only bound by exchange-only project contracts.

The cases' formalisation also varies in the extent of ex ante detail. Before the Cotton CRC commences operation, much of its operational activities and resource allocations for its entire 7-year term are specified in the Agreements. In contrast, the formalisation of the CRDC is more akin to the 'contract as framework' approach (Langfield-Smith & Smith 2003; Williamson 1991, 1996), with broad expectations outlined in government legislation, which are later developed annually.

Centralisation

The two arrangements are highly centralised as both are controlled through a separate entity staffed by dedicated managers and a Board of Directors. These 'strategic centres' (Ménard 2013) are allocated property and investment decision rights, as well as the capacity to monitor and control.

In both cases, the central entities act as intermediaries by taking ownership of the collective pool of resources contributed by funding parties, and then making investment decisions on

¹⁸⁹ The CRDC does have a 'Deed' with each research provider organisation, where the provider agrees to comply with the terms, operations and policies of working for the CRDC. However, this provides no further assurance of longer-term relation with the CRDC above that of the project-level agreements.

their behalf. These decisions are made by centralised collective bodies that are independent of any single party, such as the independent Boards of Directors; the internal management teams; or the bid team of the Cotton CRC. In distinguishing between the two arrangements, contributing CRC partners have greater discretion in allocation decisions; whereas all investment decisions in the CRDC are made by the Board of Directors.

The members of the central entities also have the authority to monitor and evaluate R&D activities of research providers. This internal monitoring function tends to be split between the Boards – who monitor the delivery of strategic objectives by the entire entity, and dedicated management staff – who monitor the operational progress of individual projects. The cases differ in the extent and intensity of these monitoring capacities. For example, the CRDC managers rely on the provider organisations for operational management control of individual projects, and monitor the progress periodically through the formal reporting process. The Cotton CRC managers also conduct periodic monitoring as well as ongoing operational control of project activities.

Relational governance

Both hybrids operate within the context of a broader relational network between commercial cotton organisations, research providers and government agencies. This network pre-exists both hybrid arrangements, emerging in the early 1970s with the formation of the ACGRA and the establishment of the publically funded ACRI in Myall Vale. Grower-researcher relations are concentrated in the cotton regions in north-west New South Wales; many researchers who work at the ACRI have developed personal relationships with cotton growers.¹⁹⁰ This sits within a looser network of relationships between cotton growers and researchers in other areas within the eastern Australian states, which have developed from direct collaborations, university education programs and interactions at the bi-annual Cotton Conference. Within this network there is a general

¹⁹⁰ For example, researchers may interact with growers through their use of surrounding commercial farms for field trials, as well as from the physical proximity of living within cotton-growing communities or family ties to cotton-growers.

appreciation of value of R&D within the cotton industry, with a sense that the work of scientists has enabled the industry to survive and remain economically viable.¹⁹¹

Both arrangements use this existing relational network to govern the R&D exchanges between government, research providers and cotton commercial organisations. Both are headquartered where grower-relations are most dense, and have relied on the involvement of individuals with strong existing ties within cotton R&D – particularly during their inception. However, as they have developed over time, the two arrangements have differed in the way they interact with this broader relational network. This manifests in the varying structure and quality of relational ties within each arrangement.

The CRDC arrangement encompasses a vertical set of relations between funding representative bodies, the central entity and the research providers. As depicted in Figure 13, party relations form different layers within a hierarchy, with the central entity in a subordinate relation to the two funding bodies, and in more dominant position over external providers. These relations are also highly centralised (Vosselman 2002), as they are completely mediated by the central entity: funders and providers only interact with the central entity, and have little direct interactions with each other. Also, there are no formal relations between competing providers.

¹⁹¹ For example, soil and nutrition research, the improved cultivars, the introduction of GM cotton varieties, and ongoing refinements in agronomy and techniques, are all perceived to have enabled Australian cotton growers to deliver yield improvements and fibre quality substantially above world standards, reduce their use of pesticides, improve their water use efficiency, and improve the profitability of their operations.

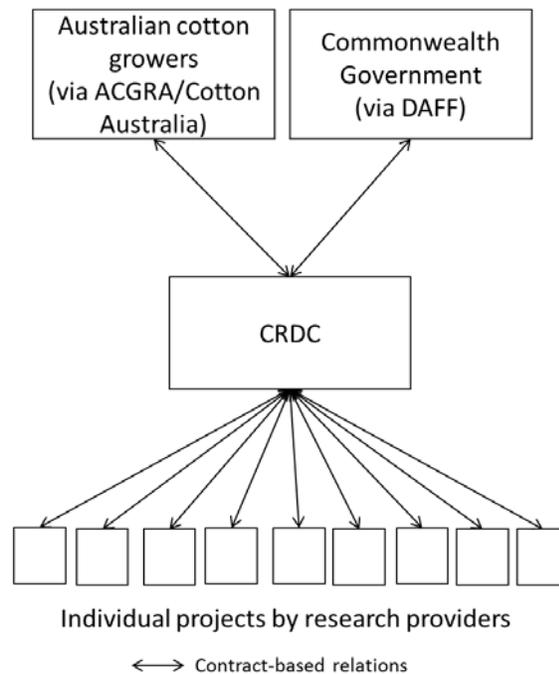


Figure 13: Structure of relations in the CRDC

The hierarchical relations also appear to have different qualities. For example, the CRDC entity maintains close, interactive, ongoing relational ties with grower funders, particularly through its relations with Cotton Australia, and compliant, yet distant relations with government funders represented through DAFF. Also, while the CRDC entity initially maintained close relational ties with research provider organisations, more recently these have become arms' length short-term contractual relations, and the CRDC attempts to foster competition between providers.¹⁹²

The relations between the Cotton CRC partners (Figure 14) are much more horizontal and lateral (Vosselman 2002). Although there remains a vertical relation between the Cotton CRC and the federal government (DIISR) there is much greater symmetry in the bargaining power of all the contributing organisations. Furthermore, because many of the contributing partners to the Cotton CRC are science organisations there are less demarcations between

¹⁹² The exception is the relations the CRDC entity has with a small minority of individual providers, within the production research program, who have worked repeatedly with the CRDC since its inception, a point I will return to in Chapter 9.

‘funder’ and ‘providers’. Instead parties are differentiated in terms of partner and non-partner organisations. The other structural feature of party relations in the CRC is the emphasis on facilitating broader cooperation and collaboration between partner organisations; these relations are not necessarily mediated by the central Cotton CRC entity.

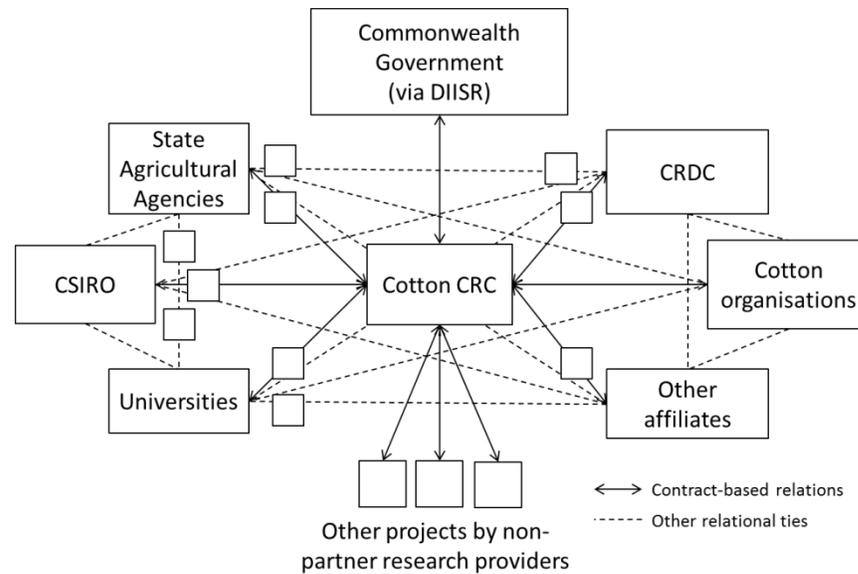


Figure 14: Structure of relation in the Cotton CRC

8.2.3. Comparing the embedded MCS

The MCS found in each of the hybrid arrangements are summarised in Table 15. Based on the categories developed from the literature review (see Section 3.4), these have been classified into four broad types of MCS, including: planning mechanisms, monitoring and reporting systems, incentives, and social mechanisms. Both case descriptions showed that MCS operated at different organisational levels, with some MCS oriented around managing the entire arrangement and others focused on managing individual projects. Thus, within the MCS categories, I have differentiated mechanisms by their scope, separating ‘structure-wide’ from ‘individual project’ MCS.¹⁹³

¹⁹³ In practice the distinction between these two levels of analysis is not always distinct. For example, in both cases there were standardised, structure-wide policies describing project management processes, which were enacted to manage individual projects. For the sake of analytical parsimony I have classified any MCS that

Table 15: Summary of MCS embedded within the hybrid arrangements

MCS type	Scope	CRDC	Cotton CRC
<i>Planning mechanisms</i>	Structure-wide	5-year strategic R&D investment plan Annual operating plan Annual budget Cash reserves	7-year strategic plan Annual operational plan Annual budget
	Individual projects	Open call and PRP/FRP proposal process Program Manager, CA panel and Board evaluations and feedback Commissioning strategic projects	Initial project list; tied contributions Open and narrow call Program Leader and CMT evaluation and feedback Commissioning projects
<i>Monitoring and reporting systems</i>	Structure-wide	Monitoring by DAFF and Cotton Australia: - Annual reporting - Quarterly financial reporting	Monitoring by DIISR and Partners: - Centre Forum - Annual reporting - Quarterly financial reporting - Year 3 and Year 5 external review - CRC final evaluation
	Individual projects	Monitoring by Board: - Reporting by Program Managers	Monitoring by Board: - Reporting by CEO Monitoring by CEO and COO: - M&E program
<i>Incentives</i>	Structure-wide	Program Manager monitoring: - 6-monthly progress reporting - Quarterly financial reporting - Final reporting	CMT monitoring: - Monthly RAG monitoring - Quarterly financial reports - Final report approval Program Leader monitoring - 6-monthly progress reports - Direct supervision/interaction - Final reports and evaluation
	Individual projects	Growers annual financial contributions (grower incentives) Continuation of CRDC program (CRDC incentives)	Partner equity contributions (partner incentives)
	Individual projects	Project payments (provider incentives) Future contract renewal (provider incentives)	Project payments (provider incentives)

had a direct impact on an individual project as project-level MCS; structure-wide MCS relate only to MCS used to manage the entire portfolio of transactions or the arrangement more generally.

<i>Social mechanisms</i>	Structure-wide	Maintain trust of funders in CRDC entity to invest in R&D on their behalf. <ul style="list-style-type: none"> - Regular information exchange - Regular interaction between CRDC and CA staff and panel members - Selection of independent, skill-based Board - Selection and retention of Program Managers 	Maintain trust of contributing partners in CRC entity to manage R&D projects and deliver collective goals: <ul style="list-style-type: none"> - Professional program leaders; in-kind managers from partners - Selection of independent skill-based Board - Regular information exchange Build 'collaborative culture' between partners: <ul style="list-style-type: none"> - Interaction at conferences, workshops - Co-location with providers at ACRI - Socialisation of junior researchers - Design of joint projects
	Individual projects	Program Manager personal interaction with researchers Prioritisation of core providers in project selection Assessment of reputation, prior ties	Program Leader personal interaction with researchers Prioritisation of partner-providers for project selection Socialisation of non-partner providers

Planning

There is extensive use of planning mechanisms in both of the arrangements, including long-term planning, annual planning and budgeting to manage the entire arrangement, and a series of proposal and evaluation processes to plan individual projects.

Structure-wide planning

In both cases, parties use long-term strategic plans to organise the overall patterns of R&D investment. These plans are similar to 'vision statements' (Miller & O'Leary 2007; Revellino & Mouritsen 2009) in that they are used to develop and communicate the overarching goals, strategic priorities, and scope of the collective enterprise; to develop shared expectations amongst funding organisations; and to garner interest of providers. They also have elements in common with 'technology roadmaps' (Miller & O'Leary 2005a; Miller & O'Leary 2007) as they direct the investment of funds towards R&D projects, and structure R&D activities into specific programs and sub-programs.

Although both entities' strategic plans are similar in time frame and overall design, they differ in their continuity over time. As each successive Cotton CRC needed to be a 'unique offering', each engaged in a stand-alone application process that resulted in distinct

strategic priorities. In comparison, despite changes in the CRDC Board's composition over time, decision-makers generally resisted altering the overall direction of the entity, meaning that the majority of the CRDC's strategic priorities were 'new from existing'.

The strategic plans also vary in terms of the involvement of exchange parties. In preparing the strategic plan, the CRDC Board engages regularly with commercial organisations, Cotton Australia and the government; however, there is minimal consultation with research organisations. In contrast, the Cotton CRC's plan is developed with a high degree of input from research providers, government and commercial organisations, as it is developed by a bid team comprised of delegates from all of the contributing partners.

The strategic plans also contrast in their level of detail. The CRDC's plans are comparatively abstract, outlining broad program areas and program-level strategic objectives and outcomes. The Cotton CRC's strategic plan is closer to the detailed technology roadmap observed by Miller and O'Leary (2005a), as it specifies program and sub-programs; operational outcomes, milestones and outputs; a list of initial projects; and budgets that specify the value, type and timing of all partner contributions for each of the 7 years.

The entities' long-term plans are enacted through annual operational plans and budgets. The level of detail in the strategic plan influences the relative intensity of annual planning cycles. For instance, as the Cotton CRC's strategic plan already includes substantial operational detail, annual planning is a relatively straightforward exercise of selecting the activities to be implemented in the current year. In comparison, the detail of the CRDC's planning is developed each year through an intensive annual operational cycle.

Project-level planning

Both organisations plan individual projects through a combination of processes, including open and targeted approaches to invite research proposals; pre-investment screening and evaluation; and feedback practices during project development. These processes operate much like the operational project planning observed in Dekker (2004), as they require researchers to develop standardised proposals outlining the expected sequence of activities, resource requirements and risks, expected benefits and outputs and a budget. Also, similar

to the use of functional analysis in Mouritsen, Hansen and Hansen (2001), in both settings the entities use project plans as the basis for communicating their expectations to providers about required outputs, functionality and delivery time. There are, however, differences in how each arrangement initiates, develops and selects projects.

One difference between the entities' project planning is their use of initiation channels. The CRDC relies on the same open call process every year to source the majority of its projects; it only occasionally commissions projects for areas of strategic importance. In contrast, Cotton CRC managers initiate projects through a number of channels – the initial project list and pre-allocated funds, open and narrow calls, and commissioning – which they use differentially throughout the Cotton CRC's lifecycle.

Differences in the arrangements' project development occur because of the variation in pre-specification of project parameters. The high level of ex ante specification in the Cotton CRC means that project planning activities focus on negotiating activities to deliver pre-specified outcomes and strategic gaps. There is more scope for emergence in project planning in the CRDC, where the strategic plan acts as a guide to developing proposals from a diverse applicant pool. This also means that project development, which is facilitated through a two-stage PRP/FRP process, takes significantly longer than in the Cotton CRC.

At the project development stage, the entities also differ in the degree of input from parties in the design of R&D projects. In the Cotton CRC partners tend to have a high level of discretion in the design of projects they are directly involved in¹⁹⁴; yet they typically have little input into others. Also, non-partner providers are given much less discretion and are typically asked to tender for commissioned projects. In the CRDC, providers are given more discretion in the initial design of projects. However, as they are subject to a more competitive tendering process, they tend to have less bargaining power in negotiation

¹⁹⁴ Partner-providers are afforded significant discretion in the design of the projects they deliver as part of their contribution to the Cotton CRC, and non-provider contributing partners are consulted with how they want their tied funds to be allocated.

stages¹⁹⁵, and are often required to alter their project to suit funder priorities elicited through the panel process.

The entities also differ in how projects are selected in terms of who is able to make operational investment decisions. In the Cotton CRC, the residual investment rights concerning individual projects are made jointly by members of the CMT. In the CRDC, although Program Managers and grower representatives provide evaluations and recommendations, the Board of Directors eventually make all project investment decisions.

Monitoring and reporting systems

Within the two arrangements there are a variety of structures and reporting systems designed to monitor the progress of activities towards achievement of structural-level and project-level objectives.

Structure-wide monitoring and reporting

The monitoring of the two entities occurs through a combination reporting that occurs between the central entity and the partners (partner monitoring) between the providers and the central entity (internal reporting).

In both cases, ‘partner monitoring’ is conducted by organisations selected to represent the interests of funding parties, such as the industry representative body and DAFF (for the CRDC), and the Centre Forum, DIISR and contributing partners (for the Cotton CRC). Both arrangements provide these organisations with annual reports to account for the progress towards the strategic plan, and quarterly financial reports which detail expenditure compared to the budget.

There are two main differences in the partner monitoring: the frequency of the reporting, and specificity of the reporting concerning performance outcomes. For example, the CRDC annual reports provide an overview of annual investment decisions and qualitative information about the progress of R&D activities towards the achievement of its operational objectives. The monitoring by funding bodies appears to focus on monitoring

¹⁹⁵ Other than the right to withdraw research proposal.

the procedural validity and regulatory compliance of the CRDC's functioning, with much less emphasis on evaluating the actual R&D outcomes developed. In comparison, the Cotton CRC entity provides partners detailed quantitative reporting of outputs, milestones and key performance indicators – items which were prescribed in the original Agreements and plans. The Cotton CRC is also subject to periodic reviews that occur in the third, fifth and final years of operation. These reviews are conducted by external consultants, who report to funding partners about the Cotton CRC's ability to deliver R&D outcomes that comply with the objectives specified in associational-contracts.

Similar to Dekker (2004), in both cases internal monitoring is enacted through multi-level internal responsibility structures. Different managerial levels correspond to a different breadth of responsibility, with independent Boards responsible for the long-term performance of the entity, internal management teams responsible for the coordinated management of the R&D portfolio, and individual Program Managers responsible for monitoring projects within their program.

The main differences in internal monitoring correspond to a variation in the degree of centralisation. For example, the high level of discretion granted to internal managers within the Cotton CRC is also accompanied by expectations that they will monitor, evaluate and report against milestones, key performance indicators and outputs. Thus managers use an extensive array of monitoring mechanisms, including monthly management by exception reporting and a centre-wide monitoring and evaluation (M&E) program, assigning performance indicators to each and every milestone of the plan. In comparison, as the CRDC Board retains much of the discretion in making decisions, internal managers are less accountable for outputs and instead are required to provide information as requested.

Project-level monitoring and reporting

For project-level monitoring, there is a high reliance on dedicated Program Managers who have expertise or knowledge of the specific areas of research and general project management. In both entities Program Managers monitor individual projects by reviewing periodic progress reports supplied by providers and evaluating final project reports.

However, the arrangements vary in the respective intensity of ex post project management efforts. Once CRDC projects commence they are monitored more at a distance, with some reliance on provider organisations to control project activities. In contrast, Cotton CRC managers complement progress report monitoring with monthly management by exception by the CMT and regular direct interaction by the Program Leaders. Also, in order for the project to be finalised it needs to be evaluated and approved by the entire CMT.

Incentives

The case material reveals the use of incentives in both arrangements to align interests of parties and make opportunism costly. These include financial incentives (Gulati & Singh 1998; Speklé 2001; Van der Meer-Kooistra & Vosselman 2000) as well as incentives related to future contracting opportunities (Gietzmann 1996; Gietzmann & Larsen 1998).

Structure-wide incentives

At a fundamental level, contributing parties' interests are aligned through the commitment of resources to the arrangements. All Cotton CRC partners underwrite their participation by committing in-kind, capital and cash contributions to the arrangement. This provides a binding equity assurance (Oxley 1997) ensuring they have a vested interest in the arrangement operating effectively and achieving its joint outcomes. The levy also provides growers with motivation to engage with R&D and provide input into the strategic direction of R&D investments.

In addition, members of the CRDC entity are motivated to use contributing funds effectively and to comply with funder priorities in order to ensure the continuation of the CRDC program. Although the CRDC is designed to run in perpetuity, as it is a statutory authority established by government mandate, there is always the possibility that a federal government may elect to modify or cease funding the RDC program.

Project-level incentives

At a project level, both entities use simple financial incentives to ensure contract compliance. Project payments are only administered once providers comply with reporting

requirements, and achieve satisfactory progress towards in-process milestones or final project outcomes.

A further incentive exists in the CRDC relating to the opportunity for contractual recurrence, which is created by the perpetual, annual R&D investment cycles, short project lengths and lack of contractual commitment with providers beyond each project transaction. Providers have an incentive to comply with the current project in order to receive favourable assessments of future project proposals. Significantly, this incentive extends beyond an individual project or researcher. This is because contract renewal decisions are made on the basis of prior experience with the providing organisation, and failure to deliver any one project is reflected in a poor assessment of the organisation overall.

Social-based mechanisms

The CRDC and Cotton also use social-based mechanisms to control individual projects and to facilitate the operation of their structures as a whole. Consistent with prior inter-organisational research (e.g. Dekker 2004; Langfield-Smith 2008; Langfield-Smith & Smith 2003; Van der Meer-Kooistra & Vosselman 2000), these social-based mechanisms include partner selection, interaction, repeated exchanges, and reputation considerations.

Structure-wide mechanisms

At a structural level, social mechanisms are used in both arrangements to maintain the 'trustworthiness' of the central entity to invest contributors' funds on their behalf. This encompasses elements of contractual, competence and goodwill trust (Sako 1992), in that the central entities ensure that parties perceive that they will honour the formalised agreements; that they have the requisite capability to make appropriate investment decisions and to manage R&D progress; and that they will behave according to the funders' interests. These different forms of trust are built through open and transparent reporting of the entities' progress, the recruitment of the highly skilled internal management teams, and the selection of independent, skill-based Boards.

Maintaining the trust of funders is apparent in the CRDC, as managers supplement reporting practices with personal interaction with grower representatives. This occurs through personal relations between the CRDC and Cotton Australia Boards and senior

management, and also between CRDC Program Managers, individual panel representatives and Cotton Australia internal staff. These relations are relatively stable and continuous, with minimal turnover of the individuals involved, particularly at the operational management level. Also, the CRDC maintain the trust of government funders through meeting expectations in periodic reporting, where CRDC managers seek to remain compliant with regulatory requirements and ‘below the radar’.

The trust that grower and government funders vest in the CRDC central entity also mediates the relation with providers: rather than evaluate the trustworthiness of each research provider, funders simply trust in the goodwill and competence of the CRDC central entity to effectively subcontract providers to deliver broader R&D outcomes. There is much less emphasis on trust-building with research providers at a structural level, as the CRDC seeks to seek to maintain a diverse provider basis and generate competition between providers.

In the Cotton CRC, the trustworthiness of the central entity has been created, in part through the long standing and repeated participation of the partner organisations and the co-location at the ACRI. In addition, boundary-spanning individuals have been used to fill administrative roles within the central entity, while simultaneously remaining employees of partner organisations.

However, the central entity sits within a broader emphasis on building a structure-wide culture around collaboration and openness between the contributing parties. In this sense, efforts are directed to building trust between the different parties, making them willing to share information, collaborate with one another, and rely on each other to work on joint projects, to deliver different components that contribute to larger goal. Managers have tried to foster a broader network of relations that are not necessarily mediated by the CRC entity amongst research providers through the design of joint projects¹⁹⁶, researcher-based conferences and workshops, co-location of researchers, and education initiatives to develop and socialise junior researchers.

¹⁹⁶ Many of the Cotton CRC projects have more than one partner organisation involved.

In addition, the Cotton CRC has promoted the development of relational ties between providers and cotton growers and communities by encouraging interaction at workshops, forums and conferences, and also liaising with cotton researchers who are called upon, on an ad-hoc basis, to provide input into industry matters in areas where they are reputed experts.

Project-level mechanisms

At a project level, both entities place significant emphasis on the role of Program Managers to develop personal relations with individual researchers. These relations became the conduit for project negotiation and development as well as project monitoring and evaluation. Both entities are also careful in screening providers to conduct projects. For example, there is preferential use of partner-providers in the Cotton CRC and in the CRDC, researcher reputation and prior experience is a component of the evaluation of project risk and selection decisions.

The significance of social mechanisms was particularly evident in transactions with experienced providers. In the CRDC, core providers, who had a history of repeat exchanges were allowed to fast track to FRP stages and were offered preferential project terms. In the Cotton CRC, managers spoke of the ‘culture’ in the production research program, where providers could be trusted to develop appropriate proposals without significant guidance. In comparison, in both cases, new providers were treated as higher risk, and typically were subject to more intensive project development, approval, and monitoring ex post.

8.3. Archetypal patterns

This section presents the results of my cross-case analysis that examines the linkages between hybrid structural characteristics and MCS. This provides an understanding of how different control solutions – hybrid structures and MCS – combine to form broader configurations or ‘archetypes’ (Kamminga & Van der Meer-Kooistra 2007; Sartorius & Kirsten 2005; Speklé 2001; Vosselman 2002).

To conduct this analysis, I first identified how each of the hybrid structural characteristics was reflected in the design and operation of embedded MCS within each case. These ‘MCS

linkages' are summarised in Figure 15 (over two pages). I then analysed the between- and within-case variation of 'MCS linkages', looking for consistent patterns in how MCS supported the functioning of hybrid structures.

In this section I present evidence of two different types of patterns that support the 'archetypal' view that the choice of MCS is driven by the structural needs of alternative hybrid forms (see Section 4.2.2). First, I show evidence of consistent cross-case variation in structural characteristics and MCS linkages; second, I find internally congruent combinations of control solutions within each case.

	CRDC		Cotton CRC	
	Structural characteristics	MCS Linkages	Structural characteristics	MCS Linkages
<i>Formalisation</i>	<p>Perpetual associational contracts between funders and CRDC</p> <p>Short-term exchange contracts with providers</p> <p>Emergent formalisation ‘contract as framework’ (contractual detail developed annually)</p>	<p><i>Planning:</i> rolling, broad strategic plans developed by Board with input from funders; intensive annual operational planning, based on standardised proposal processes with funder consultation</p> <p><i>Monitoring:</i> DAFF and CA regular monitoring of appropriateness of entity decision-making; progress report monitoring by Program Managers</p> <p><i>Incentives:</i> creates contractual incentives (financial commitment by funders; conditional project payments); and uncertainty of continuation of CRDC program and contract renewal</p> <p><i>Social:</i> focus on maintaining funder trust to make effective investment decisions</p>	<p>Finite associational and exchange contracts between all contributing partners</p> <p>Short-term exchange contracts with non-partner providers</p> <p>Highly specified ex ante formalisation, (most contractual detail developed before commencement of operation)</p>	<p><i>Planning:</i> stand-alone, detailed strategic and operational plans, developed ex ante between all partners; flexible annual planning to operationalise agreements</p> <p><i>Monitoring:</i> highly specific DIISR and Partner monitoring of the achievement of specific progress and output goals; Board and CEO use of M&E program; intense monitoring of project progress and completion</p> <p><i>Incentives:</i> creates contractual incentives (equity commitment by partners; conditional project payments)</p> <p><i>Social:</i> contributes to collaborative culture between partners</p>
<i>Centralisation of property and investment decision rights</i>	<p>Annual allocation of grower levies and government funds to CRDC</p> <p>Highly centralised investment decision-making by Board</p>	<p><i>Planning:</i> intensive annual operational planning/budgeting by Board with funder and Program Manager consultation</p> <p><i>Monitoring:</i> reporting of investment decisions in annual report to DAFF and CA</p> <p><i>Incentives:</i> creates financial commitment by funders</p> <p><i>Social :</i> independent Board Member selection; selection and retention of Program Managers; funder reliance on trust in Board to make effective investment decisions</p>	<p>Commitment of all resources ex-ante by partners and government to CRC entity</p> <p>Partners given discretion in allocation of contribution; residual investment decisions made centrally</p>	<p><i>Planning:</i> intensive preparation of bid application by partner representatives evaluated by government. Later investment decisions shaped by plan parameters</p> <p><i>Monitoring:</i> regular CEO reporting to Board, bi-annual reporting to partners about investment decisions</p> <p><i>Incentives:</i> creates partner equity incentives</p> <p><i>Social :</i> independent Board Member selection; appointment of expert Program Managers; co-investment model reinforces lateral relations between partners</p>

Figure 15: Patterns of relations between hybrid structure characteristics and MCS

		CRDC		Cotton CRC	
		Structural characteristics	MCS Linkages	Structural characteristics	MCS Linkages
<i>Centralisation of monitoring and control</i>		Periodic monitoring centralised within strategic centre Reliance on provider organisations for operational control of R&D activities	<p><i>Monitoring:</i> Reliance on periodic, standardised progress reporting monitored by Program Managers, reported to Board of Directors. DAFF and CA review strategic and annual investment plans; review quarterly expenditure; review annual reports</p> <p><i>Incentives:</i> use of conditional project payments; future contract renewals</p> <p><i>Social:</i> independent Board Member selection; selection and retention of Program Managers; high information exchange and personal interaction between CRDC and CA staff and panel representatives</p>	Ongoing monitoring and control of operational activities centralised within strategic centre	<p><i>Monitoring:</i> intense, multi-level internal monitoring structure, with numerous reporting practices (M&E program; CEO reporting; monthly RAG review, progress reporting, final report evaluation, Program Leader supervision); advisory through Centre Forum; DIISR and partners review annual reports, quarterly financial reports, and external reviews of CRC progress and outcomes</p> <p><i>Incentives:</i> conditional project payments; right of project termination</p> <p><i>Social:</i> physical proximity; regular personal interaction by Program Leaders; in-kind managers from providers; appointment of CEO, CEO, and independent Board</p>
	<i>Relational governance</i>	Vertical, hierarchical relations between funders, entity and providers Close relational ties with growers; distant, compliant relations with government; arms' length relations, open structure to foster provider competition; Prioritisation of core providers	<p><i>Planning:</i> use of open call and PRP process to maximise number of research applications; high consultation with funders</p> <p><i>Monitoring:</i> provision of 'below the radar' annual reports to government; high information exchange with grower funders</p> <p><i>Incentives:</i> reliance on contract renewal incentives</p> <p><i>Social:</i> Build and maintain trust of grower representatives with regular interactions; retention of long-term Program Managers; assessment of reputation and prior ties in project selection; fast-track core providers to FRP and offer longer duration</p>	Lateral network of relations between all partner organisations Close relational ties between CRC entity and partners	<p><i>Planning:</i> high partner involvement in ex-ante planning and latter project planning; design of joint projects</p> <p><i>Monitoring:</i> regular information exchange to partners; regular interaction between Program Leaders and researchers</p> <p><i>Social:</i> facilitate regular interaction at workshops and conferences; co-location of CRC with providers at ACRI; socialisation of junior researchers; appointment of in-kind managers and professional Program Leaders, CEO and COO; prioritisation of partner-providers in project negotiation; intense screening of non-partner providers</p>

Figure 15 (continued): Patterns of relations between hybrid structure characteristics and MCS

8.3.1. Consistent cross-case patterns in variation in structural characteristics and MCS

The first type of pattern that corresponds to an archetypal perspective is consistent cross-case variation of structural characteristics and embedded MCS. Looking horizontally across the columns in Figure 15 it appears that the variation in hybrid structural characteristics between the cases is also reflected in cross-case differences in ‘MCS linkages’.¹⁹⁷ In the sub-sections below I outline how the variation in formalisation, centralisation and relational governance are reflected in differences in the embedded MCS.

Implications of formalisation for MCS

One of the key differences between the arrangements’ formalisation is the degree of ex ante specification, ranging from highly specified ex ante formalisation in the Cotton CRC, to emergent ‘contract as framework’ approach of the CRDC. This difference appears to be reflected in the relative emphasis on ex ante long-term planning (higher in Cotton CRC) vs. annual operating planning (higher in the CRDC); and the focus of monitoring efforts in evaluating the achievement of specific outputs (in the Cotton CRC) vs. evaluating the procedural regularity of investment decisions (in the CRDC).

Formalisation also differs in terms of which parties are bound to associational arrangements. In the CRDC, only funders and the CRDC entity have long-term contractual relations, whereas all contributing partners are signatories to the Cotton CRC’s Agreements. In both cases, only parties who are bound to these associational agreements have input into the direction of the strategic plan, have the right to monitor the arrangements, and have binding financial incentives aligning their interests to the arrangements. It also appears to have significant influence on the underlying relational ties within the respective arrangements: the co-signatory model appears to contribute to the

¹⁹⁷ Likewise, it appears that where the two cases share common characteristics in their hybrid characteristics, there is also similarity in MCS design and operation. For example, in both cases, the use of short-term exchange contracts (formalisation), is linked to progress reporting (monitoring MCS) and conditional project payments (incentive MCS). In addition, the centralisation of resources and investment decisions is linked to reporting to funding parties about investment decisions (monitoring MCS), financial commitment (incentives) and selection of independent, skill-based Boards and internal managers (social MCS). Finally, the accountability to government and contributing parties (centralisation of monitoring) is linked to quarterly financial reporting and annual reports (monitoring MCS).

‘collaborative culture’ between all CRC partners; in the CRDC, its long-term contractual ties with grower funders translates into close relational ties and trust.

Finally, the entities differ in the duration of associational formalisation, with the CRDC’s formalisation continuing in perpetuity and the Cotton CRC’s Agreements having finite, 7-year terms. This is reflected in the degree of continuity of strategic plans (rolling in CRDC; standalone in Cotton CRC); the intensity of monitoring (higher in the Cotton CRC); and the use of future contracting opportunities as incentives (only found in the CRDC).

Implications of centralisation for MCS

The two cases also vary in the degree of centralisation of assets and property rights, with very high centralisation in the CRDC and more moderate centralisation tempered by partner discretion in the Cotton CRC. This is reflected in the power to make planning decisions. It also seems to correspond to the way central entities’ investment decisions are monitored by partners, with a much greater focus on monitoring investment decisions in the CRDC. In addition, the degree of centralisation appears to translate into social mechanisms, with the high centralisation placing greater emphasis on CRDC’s funder trust in the Board’s competence and goodwill; and the co-contribution model reinforcing more lateral trust between the Cotton CRC’s contributing partners.

In addition, the intensity of centralisation of monitoring and control rights is reflected in the number of layers of monitoring and reporting mechanisms. The right to periodically monitor by the strategic centre in the CRDC is reflected in the use of progress reporting by Program Managers, and the monitoring by the Board of Directors. In comparison, the higher centralisation of monitoring in the Cotton CRC is enacted through a multi-level internal monitoring structure (Program Leaders, CMT, CEO, and Board), who use numerous different types of project-level and structure-wide reporting systems. The Cotton CRC’s more intense monitoring is also facilitated through physical proximity and regular personal interaction between Program Leaders and researchers.

Implications of relational governance for MCS

One of the key differences in the relational governance between the two arrangements is the type of relations with provider organisations. In the CRDC, the arms’ length relations with

providers are reflected in the use of proposal processes to maximise diversity of applicants and fosters competition between providers, the Board's prerogative to switch providers with little assurances of continuity of funding, and the ability to use contract renewal incentives.¹⁹⁸ This contrasts the selective (Grandori & Soda 1995) and close relations the Cotton CRC seeks to foster with providers. Contributing partners are determined *ex ante* for each CRC arrangement, with a high level of continuity in terms of the organisations involved. Also, the majority of R&D projects are conducted with partner-providers; it is only when partners do not have requisite expertise that the CRC interacts with non-partner providers, and these are subject to intense screening. This prioritisation of partners in addition to co-location, in-kind manager appointments, means that over time, the Cotton CRC facilitates the development of close and enduring ties, relational norms, and repeated exchanges between a restricted set of organisations.

The other key difference is the structure of relations, with the CRDC entity mediating all relations between funders and providers, and the Cotton CRC facilitating more of a lateral network between all providers. This difference is reflected in the reliance placed on Program Managers in the CRDC to bridge different parties; whereas in the Cotton CRC managers attempt to facilitate interaction between all partners (e.g. at workshops and conferences) and design joint projects.

8.3.2. Internally congruent combinations of control solutions

The second type of pattern that supports an archetypal perspective is that each case appears to represent a distinct, yet internally congruent model for managing inter-organisational R&D. The case studies represent two different hybrid forms: the CRDC represents a flexible subcontracting arrangement (Ménard 2013); the Cotton CRC is an equity-based alliance (Ménard 2013; Oxley 1997). Furthermore, these hybrid forms represent contrasting categories of R&D alliances. Collaborative R&D arrangements are argued to exist across a spectrum ranging from more market-like purely 'contractual arrangements' to more hierarchical equity-based (Gulati & Singh 1998; Oxley 1997; Pisano 1989; Sampson 2004).

¹⁹⁸ The exception is the relations the CRDC entity has with a small minority of individual providers, within the production research program, who have worked repeatedly with the CRDC since its inception.

In this context, the CRDC arrangement aligns closely a ‘market-like’ hybrid, whereas the Cotton CRC corresponds more closely to a ‘hierarchy-like’ hybrid.¹⁹⁹

Despite the similarity of their operating context, as can be seen in Figure 15, each hybrid form is characterised by a different combination of structural dimensions. As will be detailed below, these structural characteristics generally conform to other observations of similar R&D alliances in literature. However, these structural characteristics also appear to be supported in the design and operation of different combinations of MCS. Looking down the columns of MCS linkages within Figure 15, within each case, there appears to be substantial complementarity in the design embedded MCS to suit the characteristics of the contrasting hybrid structures.

Market-like flexible subcontracting: the case of the CRDC

The CRDC is a ‘market-like’ flexible subcontracting arrangement (Ménard 2013) designed to continue in perpetuity, where the central entity acts as an intermediary that awards R&D project funding to competing external providers on behalf of its two funding constituents.

It is a highly centralised and vertical arrangement, with most of its structures and mechanisms focused on ensuring the effective investment of funds into R&D activities to address the priorities of government and grower funders. This is reflected in the formalised associational agreements that appoint two representative bodies to guide the development and execution of long-term R&D investment strategic plans; the involvement of grower-representatives in the evaluation of projects as part of the annual operating plan; and the focus on developing close relational ties between the entity and grower funders. The two representative bodies then hold the Board of Directors responsible for the effectiveness of investment decisions to deliver the strategic priorities.

¹⁹⁹ However, while prior research has tended to differentiate market-like and hierarchical forms of hybrids simply by the degree of centralisation (Gulati & Singh 1998; Oxley 1997; Pisano 1989; Sampson 2004), my results show slight variations in these patterns. As expected, the more hierarchical hybrid form (the equity alliance) had relatively higher centralisation of rights to monitor and control; however, the more market-like hybrid (the subcontracting arrangement) had relatively higher centralisation of investment decision-making rights.

Similar to other ‘market-like’ hybrids used in inter-organisational R&D (Gulati & Singh 1998; Sampson 2004), the CRDC relies on a competitive, quasi-market structure to contract with external research providers. Similar to what has been observed in previous research, the aim of this model appears to be to maintain flexibility to be able to switch to alternative suppliers in order to pursue new technological opportunities (Mouritsen, Hansen & Hansen 2001; Revellino & Mouritsen 2009). It relies on maintaining supplier competition, using short-term contracts that have little assurance of continuity, and an open annual call and PRP stage to maximise the diversity and depth of the potential applicant pool. Although external providers retain autonomy over their own operations, like in other subcontracting arrangements (Gietzmann 1996; Gietzmann & Larsen 1998), the successful delivery of outputs from current projects is motivated by various incentives, such as the reimbursement of project expenses or access to future contracting opportunities. Finally, the market orientation is reinforced through the vertical, arm’s length nature of relations between funders and providers, mediated through the central entity, who select projects on the basis to which they will deliver outcomes that suit the funders’ priorities specified in the strategic plan. Under this model, providers have little discretion in the long-term strategic direction of the entity; they have to adjust projects to suit the investment priorities of funders²⁰⁰ or risk not being selected.

The CRDC does, however, need to balance more short-term oriented government and grower priorities with longer-term issues, such as investment into R&D whose value may not be immediately apparent, the maintenance of the pool of cotton-specialised researchers, and the continuity of R&D investment through fluctuations in its highly variable funding flow. This is facilitated by the continuity of rolling strategic plans, coupled with the emergent formalisation and flexible operationalisation of strategic priorities into annual investment decisions, which are contingent on the proposals submitted and resources available for a given year. In addition, exchange parties’ interests are balanced by highly centralised control within the strategic centre²⁰¹; the independent Board of Directors

²⁰⁰ Although some providers with long history of doing cotton-specialised R&D appear to experience some advantage CRDC funding.

²⁰¹ The use of a strategic centre within the CRDC subcontracting model to mediate the exchange between funders and providers does differ from a typical ‘pooling contract’ arrangement (Gulati & Singh 1998; Oxley

ultimately makes decisions about the design of the strategic plan and the investment in individual projects. The Board is supported by the institutional knowledge and project-level operational management of Program Managers, who negotiate with providers; make recommendations about the prioritisation of core providers; and develop personal relations with grower funder-representatives.

Hierarchy-like equity alliance: the case of the Cotton CRC

The Cotton CRC, by comparison, is a highly formalised, bounded, lateral equity alliance, designed to accomplish certain outcomes within a designated time period. Like other depictions of ‘hierarchy-like’ hybrids described in the R&D alliance literature, all partner organisations combine their capabilities and resources to create a new, jointly owned entity, run by an autonomous central staff who rely on a high level of hierarchical control enacted through detailed policies and procedures and project monitoring (Dekker 2004; Gulati & Singh 1998; Oxley 1997; Pisano 1989; Sampson 2004).

Many aspects of the Cotton CRC’s operation are decided and agreed upon ex ante, including the partners, contributions, operational activities and specific outputs from those activities. The reliance on ex ante formalisation reflects the Cotton CRC’s relative certainty about resource provision as well as its limited time frame. As the bid preparation process involves all contributing partner organisations – irrespective of whether they are commercial, science based or government agencies – the resulting set of strategic, operational and budgetary plans can be highly specific. Also, the partners’ early involvement also provides them with discretion in directing where their contributions will be allocated, either through the nomination of initial projects or the tying of resources to particular outcomes. It then falls to internal managers to operationalise the detail embedded in the strategic plans. During the Cotton CRC’s operation these managers have substantial autonomy to use alternative initiation channels to develop projects and to make collective residual investment decisions to ensure the achievement of remaining strategic priorities.

1997; Pisano 1989; Sampson 2004). This may reflect broader institutional regulation requirements or alternatively, the ability to achieve cost-efficiencies in using a more intensive governance structure over a large portfolio of transactions.

The discretion granted to providers to design projects and to management staff in making investment decisions is balanced with high levels of outcome accountability. This occurs at multiple organisational levels and periods. At a project level there is regular interactive monitoring by Program Leaders, monthly management by exception, quarterly budgetary control, 6-monthly progress reporting, and final report evaluations, all of which are designed to ensure that projects comply with the in-progress and final contractual outcomes and indicators specified in the project agreements. At a more aggregate level, the Cotton CRC managers institute a centre-wide monitoring and evaluation framework, which is used to report regularly to the Board. Furthermore, the aggregate progress of all project outcomes are reported to contributing partners annually – the CRC is subject to three external reviews which ensure compliance with the associational-level Agreements.

Besides the reliance on bureaucratic policies and monitoring, the operation of the Cotton CRC relies on a network of strong relational ties amongst the contributing partners, the CRC entity and the R&D end-users that the activities are aimed at delivering to. These relational ties form the basis of a collaborative culture which is perceived to support the administration of R&D exchanges by codifying the tacit expectations and socialising researchers to adopt appropriate R&D approaches, which streamlines the managerial processes and increases the commitment to achieving the collective Cotton CRC goals.

8.4. Chapter Summary

In this chapter I have analysed the two case descriptions from Chapters 6 and 7 to describe and differentiate two alternative models of management control in inter-organisational R&D exchanges, and explain how they each address different types of cooperation control problems. This was accomplished in Section 8.2 by first comparing the CRDC and Cotton CRC using the categorisation of hybrid structural characteristics and MCS developed in Chapter 3. This comparison showed that in spite of the similarity of their operating context, including the industry, location, trading parties and transactional characteristics, the two inter-organisational R&D arrangements contrast in the type of hybrid, their structural characteristics and their embedded MCS. Then, in Section 8.3 I analysed patterns of linkages between hybrid structural characteristics and the design and operation of MCS. I found evidence of two distinct yet internally congruent models of inter-organisational R&D

management – a market-like flexible subcontracting arrangement and a hierarchy-like limited life equity alliance. Furthermore, I found the contrasting structural characteristics of these two hybrids were reflected in the particular design and operation of the embedded MCS. This supports an ‘archetypal’ view that hybrid structures and embedded MCS combine to form distinct, internally congruent combinations of control solutions.

Chapter 9: Managing cooperation problems in inter-organisational R&D exchanges

9.1. Introduction

The aim of this chapter is to present the results of the analysis that answer the central research question of how cooperation control problems, which arise in inter-organisational R&D exchanges, are addressed by the control solutions of hybrid structure and embedded management control systems. In Section 9.2, I analyse the relative control capacity of the two hybrid arrangements by examining how each of the three cooperation control problems is addressed by the design and use of the hybrid structure and embedded MCS of each hybrid arrangement. This analysis reveals that arrangements use different combinations of hybrid structure and embedded MCS to address each of the three control problems. In Section 9.3 I further explore the patterns within these results, focusing on the relative control solving capacity of the hybrid structural features compared to the embedded MCS. I present evidence supporting the misalignment approach which suggests that MCS are used to provide further safeguarding in situations when hybrid structures are misaligned to particular types of control problems or transactions.

9.2. Addressing cooperation control problems

Within the two case studies, cooperation control problems are addressed by a combination of hybrid structures and embedded MCS. The aim of this section is to analyse the relative ‘control-problem solving’ capacity to the two arrangements. Thus, having established an understanding of the general configuration of controls within the CRDC and Cotton CRC, in sub-sections to follow, I examine how hybrid structures and MCS operate as control solutions to address each of the three cooperation control problems. The results of this analysis are summarised in Figure 16 (for the CRDC) and Figure 17 (for the Cotton CRC). Based on this analysis, I then present evidence of hybrid-MCS ‘misalignment patterns’, by showing how MCS are used to address the misalignment between hybrid structure and certain types of control problems and transactions.

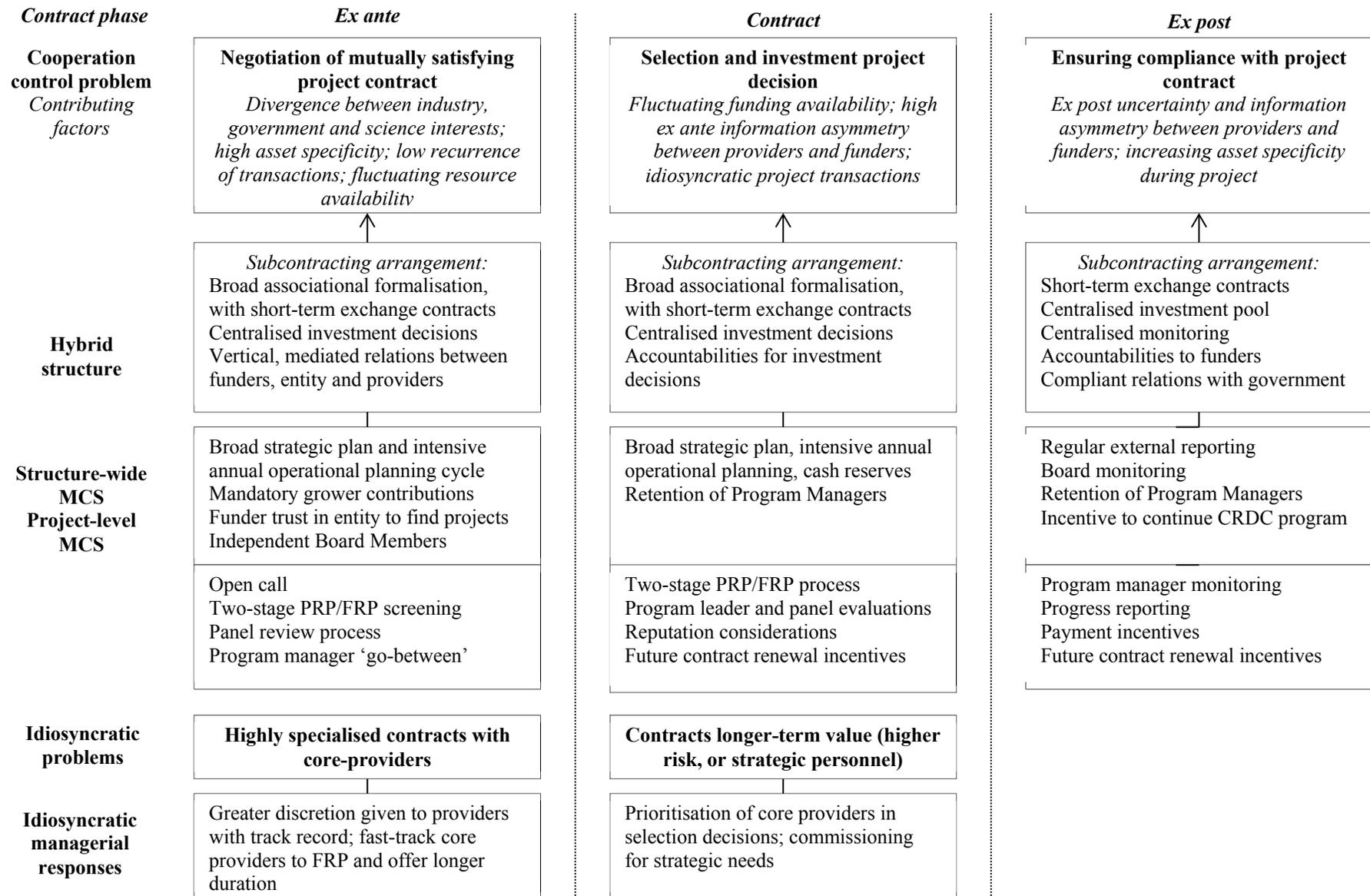


Figure 16: Cooperation control problems and control solutions in the CRDC

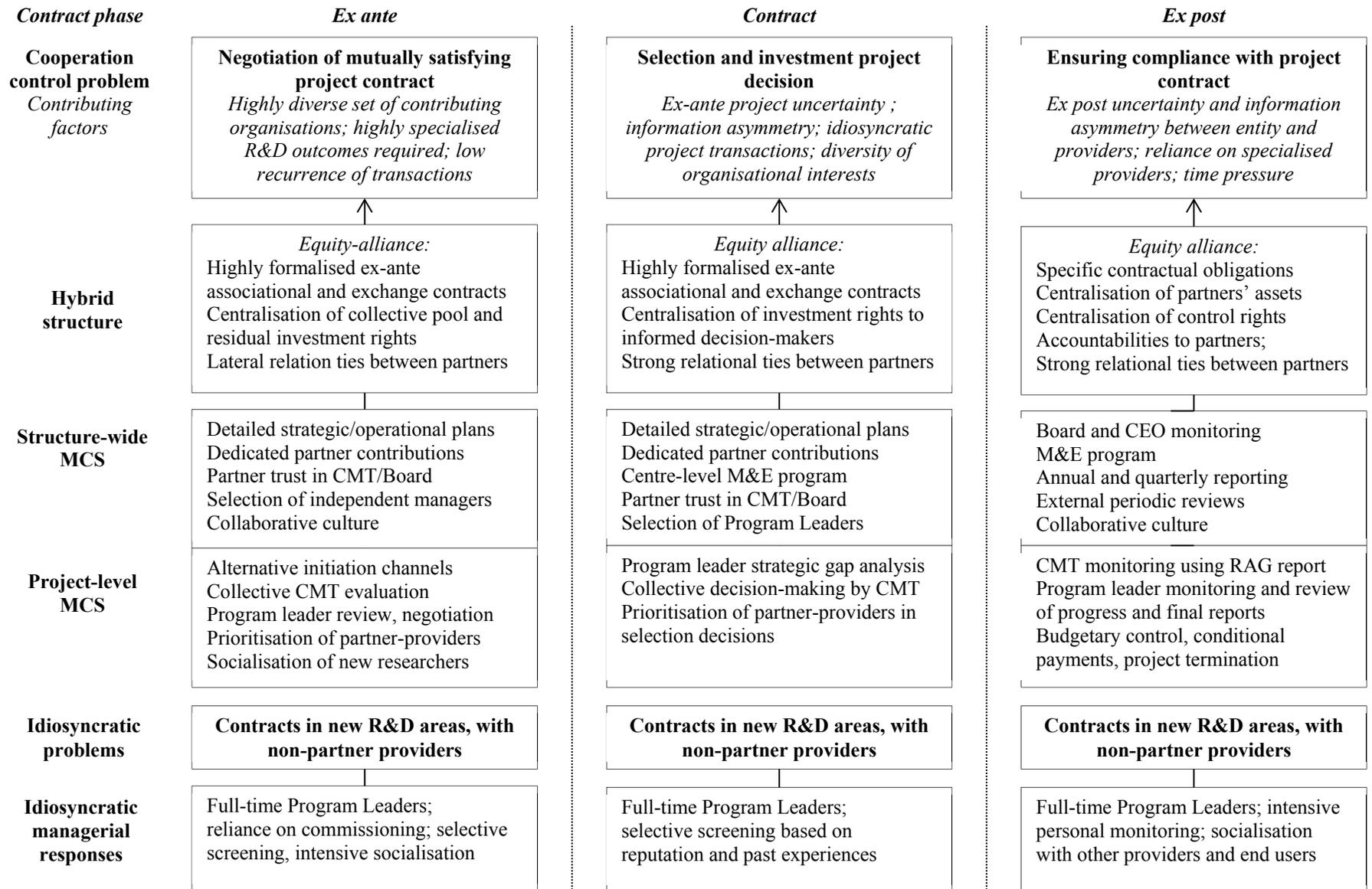


Figure 17: Cooperation control problems and control solutions in the Cotton CRC

9.2.1. Negotiating mutually satisfying project contracts

The first potential control problem arises in the preliminary stages of an R&D exchange, when parties confront the challenge of negotiating a mutually satisfying R&D contract. This a relevant problem for both arrangements due to the diversity of organisations involved, which hold divergent motives and priorities for participating in R&D exchanges. A particularly salient issue in both cases is that R&D activities need to be scientifically rigorous, yet deliver outcomes that are relevant for grower or community ‘end-users’. However, to deliver these sorts of outcomes providers need to make significant, cotton-specific investments (e.g. in highly specialised expertise, knowledge and experience; in relationships and relational-know how with other researchers, funding organisations and end users; and physical re-location to suitable research sites and investment in capital infrastructure), yet at the same time respond to their own institutional pressures to deliver broader science-based outcomes. The degree of asset specificity of cotton-R&D transactions creates mutual dependencies: funders become dependent upon cotton specialist researchers, and providers are exposed to significant costs to alter their activities or to switch to a different funding source.

Addressing negotiation issues in the CRDC

The potential for negotiation issues appear to be magnified in the CRDC due to the diversity of its funding constituents (up to 1400 cotton growers expecting industry-relevant R&D; and Australian taxpayers expecting a ‘public good’), as well as the range of external research providers it seeks to contract with. Furthermore, the fluctuating resource availability and potential for low recurrence shortens the expected pay-off period for providers’ investments in cotton-specialisation, which increases the relative asset specificity of doing CRDC R&D projects.

The CRDC addresses negotiation issues through its subcontracting structure. Through the central entity, the CRDC centralises property rights, investment rights, monitoring and relational ties – in effect operating as the central mediator between R&D exchange parties who are kept virtually separate. The CRDC uses different mechanisms to reduce negotiation issues on either side of the transaction, and then the central entity operates independently to make investment decisions that generally satisfy the parties. The operation

of this structure is supported by extensive use of MCS in developing project-level agreements.

The negotiation issues arising from funders are held in check through the creation of a single investment fund, administered unilaterally by the CRDC Board, and the appointment of funder-representative bodies. This reduces the scope of negotiation issues by limiting the diversity of interests considered in the CRDC, facilitating the development of more collective priorities that represent more aggregate concerns of growers and government.²⁰² This also has the effect of moderating asset specificity, as in order to be representative, investment decisions tend to be specialised at an industry (rather than individual) level.²⁰³

In addition to ensuring that the project-level investment decisions made by the CRDC Board align with grower interests, they hear feedback from CA panellists about both the PRP and FRP submissions. These individuals, in speaking for all growers, are trained to evaluate projects in terms of the benefit or value for the industry as a whole, rather than the relevance of the project to their own personal practice. Also, through these CRDC-panel interactions, the CRDC entity is able to build and maintain the trust of grower funders to make independent investment decisions, which are rarely questioned once made.

The CRDC's hybrid structure reduces the scope for negotiation issues arising from providers by facilitating market-like competition. While its formalisation and strategic planning practices signal its broad long-term investment intentions²⁰⁴, these are neither specific nor accompanied by any binding commitments – the CRDC retains the ability to change its investment decisions annually. Competition is also promoted by the proposal process, which intentionally boosts the number and diversity of applicants and evaluates projects comparatively. In addition, by only granting short-term project contracts, the CRDC forces providers to re-apply regularly for funding. These elements reduce the

²⁰² The government acts as a representative of Australian taxpayer interests; rather than having to ensure that R&D transactions suit the needs of individual taxpayers, or various members of government, the CRDC merely has to align to the concerns by the Minister of Agriculture.

²⁰³ 'Industry benefit' or 'public good' will be less specialised than, for example, R&D tailored to an individual funder's priorities.

²⁰⁴ These long-term strategic plans do give to providers a sense of the types projects the CRDC will likely fund (or not) for the next five years, which bounds project level negotiation, and gives some sense of the likely payoff in investing in particular areas of cotton-related R&D.

providers' leverage to act opportunistically and give the entity bargaining power to insist on modification of proposals.

Ultimately any residual negotiation issues in the CRDC are managed through the independence and authority of the central entity which has the decision rights over the design of strategy and the investment into projects. In this capacity, the Board can act as a third party mediator to balance different expectations (Tadelis & Williamson 2013). As the Board is comprised of independent members, decisions are made by people whose interests are more closely aligned to the survival of the hybrid as a going concern, rather than the short-term priorities of any individual party. Furthermore, mediation is enabled through the actions, behaviours and attitudes of the Program Managers, whose interest is aligned to the CRDC, but who expressly felt responsibility for ensuring successful negotiation of projects. They act as go-between in the two-stage proposal process, providing feedback and negotiating project development.

The accounts from the CRDC interviewees suggest that while the arrangement and project-level MCS are generally effective in handling negotiation issues, they do experience difficulty in mitigating provider-based issues. For example, the CRDC model appears to discourage researchers from developing projects that are tailored specifically to the cotton industry, as such transactions require long-term investments (e.g. relocating to the ACRI) in the context of high uncertainty about future contract opportunities. Also, the CRDC experiences issues within transactions by core providers, who the CRDC has funded consecutively for many years. These transactions appear ill-suited to the competitive model because there are no other providers who the CRDC could easily switch to. This exposes the CRDC entity to hold-up by providers, who can insist the CRDC bear more of the cost of projects. More recently, the CRDC has attempted to address these issues by granting certain providers some advantages in the project negotiation, such as allowing them to bypass the initial PRP stage, offering longer project durations, and treating prior experience in cotton R&D favourably in project evaluations.

Addressing negotiation in issues in the Cotton CRC

Given the diversity of party interests, the asset specificity of the R&D projects and the low likelihood of transactional recurrence, it would seem likely that parties within the Cotton CRC would experience negotiation problems. For example, the Cotton CRC brings together a highly diverse set of contributing organisations who often do not share a natural alignment of interests, such as: different research providers (universities, state agricultural departments, CSIRO, external consultants) who often compete for competitive funding; various state agricultural agencies with interests in serving local state constituencies; and Cotton Australia, the CRDC and research providers, who have hierarchical relations in the CRDC arrangement. In addition, in order to achieve funding under the CRC Program, parties must aim to deliver highly specialised R&D projects that deliver both commercial, community and science value. These outcomes must be achieved in a short, finite period of time, with the expectation that there will be no recurrence in funding beyond the CRC's end-date.

Despite these factors, many negotiation issues appear to be negated from the outset due to the structural features of the entire hybrid arrangement. The co-contribution CRC model, where *all* types of participating organisations contribute resources to fund the R&D, creates lateral symmetrical relations between parties and blurs the distinction between different types of exchange parties. This mitigates negotiation issues by ensuring that all parties have a substantial equity and relational stake tied to the achievement of the collective goals. This is not dissimilar to the effect of shared ownership of hierarchical organisations (Williamson 1985); CRC partners share common interest in the success of the collective venture, which motivates collaboration and attenuates incentives to sub-optimize.

Shared commitment to collective goals is also developed through the collective planning and preparation of ex ante associational and exchange contracts between the partners. Collective planning enhances partners' commitment to joint goals and also enables the allocation of specific operational activities. Significantly, members of the provider organisations are involved in these discussions; this enables the early negotiation of R&D outcomes that are both end-user relevant and scientifically feasible and valuable. Also, the

development of the initial project list and tied contributions gives partners a sense of discretion over the areas in which they are directly involved.

Structural features alleviate negotiation problems arising out of asset specificity, because it also enables contracting to occur in the context of high levels of certainty. As the Agreements provide an operational map for a finite, long-term period, providers can make decisions about investing in Cotton CRC-specialised assets with a relatively complete understanding of the nature, scope and time frame of activities these will be used for.²⁰⁵

The Agreements also develop a clear long-term mandate setting the parameters about the types of projects the hybrid will likely fund, which sets the boundaries for later negotiations once the Cotton CRC commences operation. Also, subsequent negotiation issues are mitigated by having residual investment decisions highly centralised, away from the influence of any one partner. Project evaluation and investment decisions are made collectively by internal managers whose interests are tied to the collective goals of the CRC entity, overseen by a Board of Directors that is independent of partners. Furthermore, depending on the stage of the Cotton CRC life-cycle and their tolerance for negotiation, internal managers can alter their project initiation channels, (e.g. by switching to commissioned research) to reduce the amount of provider discretion in project development.

Finally, the strong relational ties between partners increase commitment to the Cotton CRC's goals over individual organisational affiliations. This creates more willingness to compromise, share knowledge, and adjust projects to ensure the collective goals are met. The 'collaborative culture' forms part of the socialisation of individuals in partner organisations, and the development of tacit, shared understanding of the CRC 'style of R&D'. Also, partners trust in the Cotton CRC entity to make residual investment decisions appropriately.

The Cotton CRC's equity alliance model appears effective in handling negotiation issues in projects involving partner-providers; however, it experienced difficulty in the set-up of

²⁰⁵ This is not counting the other opportunities partner providers may have to use cotton-specialised assets (e.g. expertise, relations), in accessing CRDC funding in perpetuity.

projects with non-partner providers. While Program Leaders would attempt to use partner-providers wherever possible, as the Cotton CRC's mandate expanded into new areas, it became necessary to contract with external providers, particularly in the community and environment research programs. In these areas, Program Leaders often experienced difficulties in finding providers who were both suitable and willing to conduct short-term, yet highly specialised R&D projects; non-partner providers tended to design projects that suited their own institutional interests rather than reflect end-user needs. Partly, this was because non-partner providers typically were not embedded within the cotton industry and lacked the requisite knowledge to develop suitable projects. However, these problems also occurred possibly because non-partner exchanges were short-term and not bound by broader associational Agreements, and because non-partners had comparatively stronger affiliations to their own organisations. In response to these issues, the Cotton CRC hired full-time Program Leaders who used more extensive recruitment strategies and targeted commission research, and who invested in more personal interaction in developing projects with providers.

Summary

The sub-contracting model deals with negotiation through the operation of the centre entity, which remains the independent intermediary of the interests of the funders and providers, enabled through high levels of centralisation and formalisation. The equity alliance model relies on building collaborative agreement between all parties ex ante, which are formalised with detailed long-term agreements, assured through binding commitments of resources, and facilitated through the development of a network of strong relational ties. The equity alliance model is well suited for dealing with established, core research providers, and needs to adapt to contracting with non-partner providers; whereas the reverse seems to hold for the subcontracting model, which appears more appropriate for retaining arms' length short-term relations with external providers, and has needed to adapt to more long-term providers upon whom it is dependent.

9.2.2. Selecting projects for investment under conditions of uncertainty

The second cooperation hazard parties may face is the risk of making poor investment and selection decisions at the point of contract. Managers who were responsible for making investment decision showed an awareness of this type of problem. They attributed the risk of poor investment decisions to a combination of the inherent ex ante uncertainty about what R&D projects were likely to deliver; the difficulty in assessing the comparative value of idiosyncratic proposals; and the risk of provider misrepresentation arising out of information asymmetry.

Addressing selection issues in the CRDC

Selection concerns are salient in the CRDC because investment decisions are made by independent Board Members, who have limited terms, little direct interaction with providers, and who do not necessarily have experience in the cotton industry or proficiency in the underlying areas of research. Therefore, there is a high degree of information asymmetry between decision-makers and research providers, which providers could exploit by misrepresenting their capabilities or the project parameters. Also, because associational formalisation is intentionally open-ended, it does not provide much in the way of formal decision criteria. Finally, the CRDC intentionally seeks to maximise the diversity of its project applications, which potentially increases the idiosyncrasy of projects, making comparisons between alternative options difficult.

To address these selection issues, the CRDC relies on a combination of structure-wide and project-level planning mechanisms. There is considered development of the long-term strategic R&D investment plan used to guide selection decisions throughout each 5-year period. This is complemented by intensive annual operational planning, with high reliance on the two-stage proposal process. Providers are required to supply a lot of information, with opportunities for decision-makers to ask for further clarification. The risk of poor selection is also reduced by having multiple rounds of review by dedicated Program Managers and CA panel members. These individuals are not scientists; however, their long tenure enables the accumulation of institutional and historical knowledge about prior projects and a sophisticated working knowledge about the relevant science.

The panels and Program Managers also manage adverse selection through the prioritisation of reputation, prior experience, and relational ties, when assessing the potential partners. During evaluation rounds, proposals are subject to rankings by individuals, as well as unstructured assessments by the group at panel meetings, which reduces the risk of gaming.²⁰⁶ The CRDC reserves the right to select projects according to somewhat idiosyncratic criteria. The Board is also able to make comparative decisions, as having portfolios of related transactions creates richer sets of information about comparable projects.

Finally, selection issues are mitigated through the anticipation of ex post consequences. All projects are subject to standardised short-term project agreements, which provide contractual recourse for misrepresentation (e.g. withholding payment). In addition, because all providers are generally kept at arms' length, those wishing to obtain future contracts have an incentive to not misrepresent in the short-term. This is magnified by the centralisation of R&D funding in the cotton industry²⁰⁷, which reduces the ability of an opportunistic provider to switch to another funding source without incurring significant cost.²⁰⁸

Despite the combination of planning, information gathering and incentives, the CRDC still faces persistent selection issues, particularly in relation to projects whose pay-off extends beyond the current project length. This is because the short-term exchange contracts, coupled with the fluctuating resource availability, introduces complex decision trade-offs, such as between projects that are short-term, low-risk and easy to understand, and long-term, high-risk, more fundamental science projects that are harder for decision-makers to interpret and value. In this context it is sometimes difficult to justify the selection of projects with a longer-term value within the annual investment cycle, even if they are more

²⁰⁶ Gaming could occur when a provider intentionally exploits a known information gap in standardised information provision.

²⁰⁷ This has subsequently increased further with the closure of the Cotton CRC, meaning the CRDC is ostensibly the only funder of cotton R&D.

²⁰⁸ Centralisation of assets also reduces each funder's individual exposure to poor selection decisions, as they are able to spread and share their risk across a portfolio of collective transactions. R&D funders potentially may therefore tolerate a higher degree of risk than they normally would, meaning they may be willing to invest in projects without complete contracts, or those that are inherently more risky (e.g. basic research).

likely to deliver more transformational outcomes for the industry. Similarly, the project selection process struggles to accommodate the strategic value of highly experienced cotton R&D personnel. Not funding a project by a cotton specialist presents a significant knowledge management risk, as these individuals – with unique, possibly strategically valuable tacit skills and expertise – may leave the cotton R&D network. To respond to these complexities the CRDC occasionally varies its project selection processes for projects by ‘core providers’. For example, it may give them priority in the PRP/FRP process, include the strategic value of researchers in project decisions, and if necessary commission projects outside the PRP/FRP process to ensure key personnel continue to be engaged in cotton R&D.

Addressing selection issues in the Cotton CRC

In the Cotton CRC selection issues are addressed primarily through the involvement and preferential selection of partner providers. These scientific organisations have an equity stake in the achievement of collective goals and have less incentive to misrepresent. Their participation increases the scientific expertise of decision-makers and minimises information asymmetry between the entity and prospective researchers.

Once the Cotton CRC commences operation, the uncertainty of project-level selection decisions are bounded by the detail and finite time frame of the requirements of the ex ante Agreements, which give clear criteria for the acceptance of new projects. In addition, all projects are evaluated according to standard criteria, by the collective expertise of the entire CMT.

Only a subset of transactions appears to cause problems in terms of selection, which are the projects by non-partner providers. This occurred initially because the internal managers did not have the expertise to be able to evaluate the projects. Furthermore, as non-partner providers were not bound to the CRC entity beyond short-term contracts, there is a perception that these providers are more likely to exploit information asymmetry to get funding, cause problems and then leave. In response, the Cotton CRC elected to hire two full-time Program Leaders to manage the community and environment research programs; they both invested time in developing specific commissioned tenders for research projects,

screening potential applicants, and building ongoing relational ties with providers with whom they had positive project experiences.

Summary

On the whole, it appears the ongoing risk of adverse selection is significantly less in the Cotton CRC because of the high degree of involvement of scientists from provider organisations in the planning and decision-making of the central entity. In addition, once it commences operation, decisions are made in a highly specified information environment, with detailed strategic plans to execute within a clear finite time frame. The entity is able to leverage the collective interests and expertise of these providers to ensure that projects are not misrepresented. This is made evident in the difficulties it experiences when contracting with non-partners providers in areas of research that lay beyond the areas of initial expertise of Cotton CRC partners and management.

In comparison, the CRDC's model seems more exposed to information asymmetry gaps between decision-makers and research providers, created by arms' length relations with providers, and the centralisation of investment decisions to the Board. Furthermore, decisions appear to occur in more complex scenarios, created by the perpetual nature of the CRDC, the fluctuating resource availability, the open-ended associational formalisation, and the reliance on short-term exchange contracts. This potentially explains why the CRDC has a much more intensive ex ante pre-investment project screening process. To compensate for the Board's relative lack of expertise, the proposal process enables the collection and consideration of information supplied by providers; the evaluation of proposals by experienced Program Managers and panel members; and relative portfolio-based comparisons of individual projects.

9.2.3. Ensuring ex post compliance with R&D exchange expectations

The R&D funders face difficulties in ensuring that providers comply with and fulfil project contractual obligations. There is the risk that, once the project commences, providers will act to suit their own needs, such as by shirking effort to concentrate on other activities, or altering the project to address their own career or scientific objectives. This risk appears to be particularly acute in inter-organisational R&D exchanges due the ex post information

asymmetry that emerges between R&D funders and decentralised research providers. Often it is difficult to evaluate whether variation from contracts has occurred due to contingencies arising from the science or from malicious intent. Also, as projects develop, the funders are exposed to increasing dependence on research providers as it becomes prohibitively difficult or costly to switch to an alternative provider.

Addressing compliance concerns in the CRDC

Within the CRDC, funders ensure ex post compliance of contracts by holding the CRDC Board accountable for the monitoring and delivery of R&D outcomes which they demonstrate through quarterly expenditure reports and annual reports. In turn, the CRDC Board monitors research providers through dedicated Program Managers, who review regular progress reports that account for the achievement key performance indicators (KPIs), milestones, and objectives specified in exchange contracts. Although variances from targets are still interpreted with care (because ex post uncertainty may cause variation outside the researchers' control), having ex ante specification still allows for a variance to be constructed. Furthermore, variances are interpreted by experienced Program Managers, who have the capability to make informed project-level evaluations.

Compared to the Cotton CRC, the CRDC's ex post monitoring is less regular and intense; more reliance is placed on the provider's to govern their own researchers. This is because contract compliance is also ensured by tying progress report evaluations to contractual bonding mechanisms, such as conditional project payments, which make non-fulfilment costly. CRDC projects are also held in check by the contract renewal incentives, as providers are motivated deliver outcomes which are perceived as beneficial and valuable to the funder, and otherwise refrain from any form of opportunism as their future business is at stake. However, the power of contract renewal incentives are undermined by variable funding flows which reduce the exogenous likelihood of contract renewal – even researchers with good track records may not receive future funding because of a contraction in production.

Although this concern was not raised by interviewees, it appears that the CRDC is also potentially exposed to greater compliance issues for transactions with providers in new

areas (for which it does not have the same level of expertise), or for once-off transactions. The effectiveness of contract renewal incentives is reliant on a competitive market for R&D funding and the motivation for providers to seek contract renewal. This may be less effective if providers are happy to accept one-off or infrequent transactions; for example, if they have alternative funding sources available.

Addressing compliance concerns in the Cotton CRC

Concerns about ex post compliance are particularly salient in the Cotton CRC because of the specificity of the associational-level contractual obligations and the time pressure introduced by its limited life. Although this does not increase the change of ex post contingencies occurring, it creates a lower tolerance of variability and also increases the cost of ex post uncertainties.

To address this concern, the Cotton CRC is subject to a greater intensity of monitoring, both at a project level and centre-level. In addition to progress reporting, CRC projects are subject to monthly management by exception reviews (RAG reporting) and direct supervision by dedicated Program Leaders. Projects that are not progressing to plan are subject to budgetary constraints and payment control, interventions as suggested by the CMT, and potentially termination. In addition to the quarterly financial reporting and annual reporting, the Cotton CRC Board and CEO provide bi-annual updates to partners (via the Centre Forum) and use an extensive internal M&E system that tracks the accomplishment of all milestones and outputs in the Agreements. Furthermore, the entire CRC operation is subject to three external consultant reviews, which evaluate the likelihood of achieving the Agreements and provide binding recommendations to the CRC Board.

The Cotton CRC also relies on the use of relational governance and a shared sense of joint ownership by providers to mitigate ex post compliance concerns. For example, it invests in regular workshops and conferences to bring together different providers and end users, in an attempt to socialise researchers to understand the value of collaboration towards collective goals and the relevance of commercial R&D outcomes.

Ensuring contract compliance appears to be most difficult in the new R&D areas with non-partner providers. This was because of the perceived lack of non-partner provider interests

in the broader Cotton CRC outcomes, as well as higher information asymmetry between the entity and decentralised, remote providers. Thus partway through its operation the CRC hired two full-time Program Leaders who could become more proficient in these R&D areas and frequently interact face-to-face with providers.

Summary

To manage ex post concerns, both arrangements rely on accountability centralised through the entities internal management structure, regular progress reporting according to contracted milestones, objectives and outputs, and performance-contingent project payments. The CRDC, with its perpetual lifespan, appears able to rely on contract renewal incentives to curb threats of opportunism. In comparison the Cotton CRC, with its limited life, appears to be under substantially more pressure to diagnose, manage and rectify emergent issues, and thus relies on much more regular and intensive project management by internal managers.

9.3. Misalignment patterns

This section presents the results of my cross-case analysis of the relative control capacities of the two arrangements. This provides an understanding of how different control solutions within an inter-organisational arrangement contribute to managing cooperation control problems, and particularly, how MCS may be used to provide additional safeguarding in situations of when hybrid structures are misaligned (Anderson & Dekker 2005; Johansson & Siverbo 2011; Sampson 2004).

From the preceding discussion it appears that while in some instances the arrangements were able to mitigate or manage cooperation problems simply through their structural characteristics, in other situations, there was much more reliance on embedded MCS to ensure opportunism did not occur. My analysis focuses on identifying patterns in the relative adequacy of hybrid structures and the reliance on embedded MCS.

In this section, I present evidence of two types of patterns that support a ‘misalignment’ perspective that MCS are used in situations when the particular hybrid governance structure is insufficient to address the severity of cooperation hazards (see Section 4.2.2). First, I show that the intensity of MCS across different contractual phases correspond to patterns in

the adequacy of hybrid structures in addressing the different cooperation control problems. Second, I show how each arrangement relies on idiosyncratic MCS responses to cope with particular instances of transactional misalignment.

9.3.1. Intensity of project-level MCS for different control problems

The first type of pattern that corresponds to the ‘misalignment’ perspective concerns the relative intensity of project-level MCS used to address different cooperation control problems. An earlier study by Johansson and Siverbo (2011) showed how MCS safeguard against misalignment by observing the relative intensity of MCS use in relation to a *single* estimation of cooperation hazards and governance misalignment per arrangement (Johansson & Siverbo 2011). I extend this approach by examining the intensity²⁰⁹ of MCS use in relation to *three* cooperation control problems occurring at different contractual phases.²¹⁰ By taking this more nuanced approach towards cooperation control problems it is possible to observe case-unique patterns in the intensity of project-level²¹¹ MCS (see Table 16).

Most of the CRDC’s use of project-level MCS was focused on the ex ante and contracting stages of R&D exchanges, with much less intensive use of MCS in latter ex post stages. In early stages of projects, CRDC Program Managers work intensively with research providers to develop project proposals, acting as a ‘go-between’ with funder representative and the CRDC Board, through two rounds of review and feedback. The CRDC also relies heavily on this two stage PRP/FRP process to alleviate selection problems, encompassing successive rounds of formal review and evaluation by the Program Managers, the CA panels and the CRDC Board. However, once CRDC projects commence, they are managed,

²⁰⁹ By intensity of use I refer to the time and effort intensity of managers in using MCS during these different phases of R&D project contracts, where higher intensity represents situations where managers are using more control practices, paying greater attention to their use, with a high frequency and regularity.

²¹⁰ Although it was not possible to assess MCS intensity using cross-sectional quantifiable measures (e.g. in Johansson & Siverbo 2011), within the qualitative case descriptions it appeared there was variation in the different contractual phases, in both the relative intensity or emphasis on project-level MCS mechanisms in managing alternative control problems.

²¹¹ I have chosen to focus on patterns in project-level MCS; it is easier to assess their use in relation to specific control problems as they tend to be used at specific points in a project lifecycle. By comparison, structure-wide MCS tend to relate to all three control problems, making it more difficult to assess their relative intensity of use across contracting phases.

typically at arm’s length, through 6-monthly progress reporting that ensures contractual compliance.

The respective intensity of project management efforts are reversed in the Cotton CRC; low intensity of project-level MCS in project negotiation and selection, and high intensity of project monitoring and compliance. The Cotton CRC’s *ex ante* activities focus on executing the strategic plan and Agreements, by reviewing and negotiating projects with existing providers or external providers that deliver against specific gaps. *Ex post*, internal managers in the Cotton CRC complement progress report monitoring with monthly management by exception by the entire CMT, and Program Leaders provide regular personal monitoring; there is also greater scrutiny of the final report.

Significantly, the variation in intensity of project-level MCS appears to correspond to the relative adequacy of structural features of the hybrid arrangements in addressing the different cooperation control problems (see Table 16).²¹² The relative adequacy of the hybrid structure represents an assessment of the risk of opportunism occurring in the absence of MCS.

Table 16: Relative intensity of MCS use

Transactional phase	CRDC			Cotton CRC		
	<i>Ex ante</i>	<i>Contract</i>	<i>Ex post</i>	<i>Ex ante</i>	<i>Contract</i>	<i>Ex post</i>
Control problem	Negotiation	Selection	Compliance	Negotiation	Selection	Compliance
Adequacy of hybrid structure	Low	Low	High	High	High	Moderate
Relative intensity of project-level MCS use	Moderate	High	Low	Low	Low	High

For example, the CRDC’s market-like subcontracting structure is exposed to both negotiation and selection problems. It is vulnerable to negotiation problems because of the

²¹² The relative adequacy of the hybrid structure represents an assessment of the risk of opportunistic behaviour occurring in the absence of the control provided by the embedded MCS.

use of short-term contracts, centralised investment decision-making, and arm's length relations with providers; this creates uncertainty about future contract renewals and thus makes it difficult to convince providers to make funder-specific investments. This corresponds to Gietzmann and Larsen (1998) who argue that, in the subcontracting arrangements, suppliers will evaluate whether to invest in skill specialisation now in the context of the likelihood of future work opportunities.

In addition, the CRDC is exposed to the risk of making suboptimal selection decisions. This is because selection problems are largely driven by the extent of information asymmetry between the parties making investment decisions and prospective providers. For example, in Mouritsen, Hansen and Hansen (2001), decision-makers that had less technical competency were more likely to be at the 'providers' mercy', and were more exposed to the risk of making less effective selection decisions. Selection problems may even be exacerbated by structural features of CRDC's centralised subcontracting model, such as the centralisation of investment decisions to an independent, non-expert Board; the broad perpetual associational formalisation and lack of detailed decision criteria; the annual fluctuations in resource availability; and the use of short-term exchange contracts and arms' length relations with a diverse range of providers.

Both negotiation and selection problems appear to be addressed through the CRDC's use of project-level MCS. For example, negotiation problems appear to be minimised through the use of open calls and PRP/FRP processes that maximise the number of potential applicants and the personal mediation of the project proposals through multiple rounds of review by the Program Managers.

A similar pattern can be observed in the Cotton CRC control responses to ex post compliance concerns. Ex post control problems are particularly salient in the hierarchy-like equity alliance because of the specificity of the associational-level contractual obligations and the time pressure introduced by its limited life. Furthermore, because all CRC partners share responsibility to achieve the formalised associational agreements outcomes, without further means of measuring individual partner activities or contributions, there may be less intense incentives for each partner to perform (Alchian & Demsetz 1972; Williamson

1981). Therefore, in absence of further MCS, the Cotton CRC would be exposed to significant risks of not achieving its agreed outcomes and potentially being forced to accept sub-optimal performance due to the limited duration of the projects and organisation. This risk of ex post non-compliance is addressed through multiple monitoring and reporting systems.

9.3.2. *Instances of transactional misalignment*

The second type of pattern which corresponds to the misalignment perspective is the existence, in both cases, of particular types of transactions that do not appear well suited to each configuration of hybrid and MCS control solutions. This pattern builds from earlier studies that use higher ex post control problems as evidence of transactional misalignment (e.g. Anderson & Dekker 2005; Johansson & Siverbo 2011). Although I do not measure the degree of ex post control problems for all contracts administered within each hybrid arrangement, I do observe that within each arrangement, managers consistently identify certain sets of transactions as having a higher risk of opportunism. Furthermore, these particular groups of problematic transactions also appear to prompt idiosyncratic MCS responses (described in the bottom of Figure 16 and Figure 17).

While the CRDC's flexible subcontracting arrangement appears well-suited to enabling investment in emergent research opportunities, it seems to experience difficulties in negotiating R&D exchanges with core providers. This is because such transactions are characterised by high asset specificity arising out of 'fundamental transformation' that occurs with repeated exchanges (Williamson 1985). As individual researchers have repeatedly had their funding renewed, they develop cotton-specific expertise that becomes more difficult to replace. Also, some core providers' projects have created large longitudinal data sets; these projects are often renewed almost automatically, as their value depends on the uninterrupted accumulation of comparable year-on-year data. These transactions do not fit well within the competitive subcontracting model, as the high asset specificity creates funder dependence and opportunities for hold-up in negotiations. Furthermore, these sorts of transactions, with longer-term capacity implications, appear to create complex trade-offs in investment decisions at selection phases.

The CRDC responds to the problems through various initiatives tailored specifically towards its nominated core providers. These providers are given different conditions during project proposals, such as options to fast-track to FRP stages, offers of commissioned projects, and longer project durations. Furthermore, as provider reputation is often considered in project evaluations, often these providers are prioritised in the selection recommendations made by the panels and the Program Managers.

The Cotton CRC's hierarchy-like equity alliance appears to be well-suited to contracting with partner-providers; however, it was challenged in all three contractual phases by transactions with non-partner providers. This is because such transactions are characterised by higher information asymmetry, and higher asset specificity without any matching assurances of continuity or commitment.

These transactions do not fit the equity alliance model as they are with parties who do not share existing contractual or social relations with the Cotton CRC who are not bound by the Agreements; who do not share a long history of working with Cotton CRC members; and who retain strong host-organisational affiliations. Furthermore, one-off transactions with non-partner providers are also characterised by relatively higher information asymmetry and higher asset specificity.

In response, the Cotton CRC uses full-time Program Leaders to manage research areas with non-partner providers, who elect to use much tighter project initiation channels and spend considerable time screening, socialising and interacting with providers that appear capable and willing to deliver the Cotton CRC R&D outcomes.

9.4. Chapter summary

This chapter presents the analysis of empirical material in order to address the research question proposed in this thesis: how cooperation control problems, which arise in inter-organisational R&D exchanges, are addressed by the control solutions of hybrid structures and embedded MCS. In Section 9.2 I analysed the relative control capacity of the two hybrid arrangements by examining how each of the three cooperation control problems were addressed by the design and use of hybrid structures and embedded MCS. I found that within each arrangement, each cooperation control problem was addressed by a different

combination of hybrid structure and MCS. This analysis shows that the two hybrid arrangements have quite different ‘control-problem solving’ capacities in responding to cooperation problems.

I explored the nature of this control capacity in Section 9.3. I found that while in some instances cooperation control problems were managed largely through the hybrid structural characteristics, in other situations, there was much more reliance on embedded MCS to ensure opportunism did not occur. This appears to indicate that structural differences between the alternative hybrid forms contribute to variation in their ‘control solving capacity’ to address different types of control problems and different types of transactions. In addition, this analysis reveals patterns consistent with a misalignment view of MCS within hybrid arrangements. These patterns include variation in the relative emphasis on project-level MCS to compensate for weaknesses in hybrid structures at different contractual phases, and different instances of transactional misalignment which prompts idiosyncratic MCS responses.

Based on this analysis, in the next chapter I will explore the nature of relations between inter-dependent control solutions, and between control solutions and control problems. This will enable the development of broader theoretical implications about how and why control problems are addressed by combinations of inter-dependent control solutions.

Chapter 10: Implications

10.1. Introduction

The aim of this chapter is to reflect on the broader theoretical implications of the empirical finding of the study. These theoretical implications concern the two key relations within my conceptual framework: the relation (inter-dependencies) between different types of control solutions and the relation between control problems and control solutions.

In Section 10.2, I examine the nature of the interdependencies between different types of control solutions, by explaining how and why variation in hybrid structures influences the design and use of embedded MCS. Based on my empirical results I reflect on the significance of the varying control capacities inherent in the structural characteristics of alternative hybrid governance modes: these structural characteristics not only act as first-order control solutions to cooperation problems, but they also influence the design and use of embedded MCS. I propose that some MCS are used to complement the strengths of alternative hybrid structures, and some MCS are also designed and used to compensate for hybrid structures' weaknesses. Furthermore, I explain how these different types of hybrid-MCS interdependencies can co-exist within the same arrangement.

In Section 10.3 I consider the issue of how control problems and control solutions relate. I conceptualise the dynamic between control problems and solutions in general to explain how and why control solutions align to control problems. I apply then this general explanation to develop a model depicting why different control solutions are used to address cooperation control problems in inter-organisational R&D. Finally, I explore the contexts where the relation between control problems and solutions are not expected to hold, and explain why misalignment between cooperation control problems and solutions occurs.

10.2. Relating control solutions

The aim of this section is to explore the nature of the interdependencies between different types of control solutions, by explaining how and why variation in hybrid structures influences the design and use of embedded MCS. This extends our understanding of inter-

organisational management control by illuminating the control capacity of alternative hybrid governance modes; by showing how and why variation in MCS is influenced by hybrid type; and by clarifying the nature of the inter-dependencies between the choice of hybrid control solutions and choice of MCS.

To address these issues, I return to the conceptualisations I identified in the prior literature (Chapter 4) regarding the interdependencies between hybrid governance and MCS control solutions. Recall that a substantial proportion of inter-firm control research simply includes hybrid-level antecedent factors as explanatory variables for MCS variation (e.g. prior partner experience). Although these variables can proxy for differences in hybrid arrangements, they have limited ability to explicate the effect or control capacity of alternative hybrid structures. Thus, this approach tends to treat alternative hybrid arrangements simply as the generic inter-organisational relationship context for control.

A smaller collection of studies has conceptualised both hybrid governance structure *and* MCS as control solutions. As discussed in Section 4.2.2, it appears that these studies have used one of two approaches to explain how the choice of hybrid structure relates to choices of embedded MCS. Conceptual frameworks using an ‘archetypal approach’ suggest that MCS will be driven by the need to facilitate the operation of the hybrid, and thus will be designed to support the specific structural characteristics of each hybrid type (e.g. Kamminga & Van der Meer-Kooistra 2007; Sartorius & Kirsten 2005; Speklé 2001; Vosselman 2002). In comparison, empirical studies, adopting a ‘misalignment approach’, suggest that MCS will be used to compensate for weaknesses in a governance structure’s capacity to address the cooperation hazards of a given transaction (Johansson & Siverbo 2011; Sampson 2004).

Although the nature of my research design did not allow for the direct observation of the process of choosing control solutions, or for quantitative testing of alternative hybrid-MCS relations, the results described in Chapters 8 and 9 provide can insight into the relation between hybrid structures and MCS. Overall, two different types of hybrids, operating within a very similar context, used different combinations of MCS, in varying degrees of intensity, in response to three cooperation control problems. This provides a *prima facie*

case that the hybrid type, at least partially, shapes the design of the embedded MCS. Furthermore, cross-case patterns provide empirical evidence about how variation in the structural characteristics of different hybrid arrangements influences the design and use of embedded MCS.

In the subsections below, I discuss the theoretical implications of these cross-case patterns. First, in Section 10.2.1, I explain how variation of hybrid type translates into variation in the structural control capacity of alternative inter-organisational arrangements. This varying control capacity forms the basis for understanding the different hybrid-MCS relations. As explained in Section 10.2.2, some MCS are designed and used to complement the control capacity (strengths) of alternative hybrid structures. Alternatively, as explained in Section 10.2.3, MCS are also designed and used to compensate for hybrid structures' control deficiencies (weaknesses). I reconcile these alternative explanations in Section 10.2.4, by explaining how different types of hybrid-MCS interdependencies can co-exist within the same arrangement.

10.2.1. *The varying control capacities of alternative hybrid forms*

As described in Chapter 3, one of the limitations of existing inter-organisational control research has been a tendency to equate hybrids with 'inter-organisational relationships' (Caglio & Ditillo 2008; Van der Meer-Kooistra & Vosselman 2000). The use of this generic, aggregate label has prevented the development of a systematic understanding of the management control implications of alternate hybrid forms, as it obscures the full spectrum and diversity of hybrid types.

In contrast, the results reported in Chapter 8 confirm the broader economic literature (Grandori & Soda 1995; Ménard 2004, 2013) by demonstrating the structural diversity within the hybrid category. These findings reveal that two different hybrid forms – a limited life equity alliance and flexible subcontracting model – contrast in their structural characteristics. For example, the results for the more 'market-like' flexible subcontracting model relies on standardised short-term contracts, supplier-competition, decentralised monitoring, renewal incentives, and arm's length relations with suppliers; whereas the more 'hierarchy-like' equity-based alliance bounds partners through equity commitments and

relies on high levels of ex ante formalisation, high centralisation of monitoring and control, and strong lateral relational ties between parties. These results show that different hybrid forms do not constitute equivalent inter-organisational relationships; rather they constitute structurally distinct organisational configurations for managing inter-organisational exchanges.

A second limitation of earlier inter-organisational control work is the tendency to treat hybrids as the context in which cooperation problems are addressed by different patterns of MCS and thereby overlook the structural control capacity of the arrangements themselves.

My results presented in Chapter 9 show that the structural characteristics of hybrid forms are a significant source of management control in addressing cooperation control problems. As an example, hybrids' structural characteristics address behavioural issues by creating a sense of continuity in contracting. This is achieved through a combination of the centralisation of property rights, which creates large bundles of related transactions; the centralisation of investment decision-making, which enables the development of institutionalised expectations and preferences; associational formalisation, which specifies the boundaries for investment decisions, establish commitments of resources, and structure contracts into portfolios of related transactions; and relational governance, which establishes 'transactional reciprocity'. By creating a sense of continuity in contracting, hybrid structures address cooperation problems by reducing the perceived asset specificity of any single transaction (from a providers' perspective) and indicating the related opportunities where asset-specific investments may be used without loss in value (Tadelis & Williamson 2013).

Taken together, these two findings – that hybrid forms vary in their structural characteristics, and structural characteristics have control solving capacities – justify the overt consideration of the type of hybrid in inter-firm control research, as different hybrid forms will have varying control capacities to address cooperation control problems.

The relative strength of hierarchy-like hybrids is their ability to create alignment between a diverse set of organisational parties towards a collective goal, through a combination of high formalisation, high centralisation of property rights, and intense, lateral relational

governance between a selective group of parties. In addition, the specificity of ex ante formalisation, involvement of provider parties, and centralisation of the rights to control, also give hierarchy-like hybrids an information advantage. The individuals responsible for decision-making and control have the high levels of expertise that reduce exploitable information asymmetries.

Market-like hybrids, by comparison, rely on a combination of generating supplier competition and incentive intensity, which are created by vertical relational governance, high centralisation of property and investment rights, and short-term exchange formalisation. Buyers can switch to alternative parties if providers attempt to engage in hold-up, misrepresent, or sub-optimize on any single transaction.

Therefore, the type of hybrid structure is significant as different hybrid forms, characterised by different combinations of structural characteristics, will have alternative ways of addressing cooperation control problems. Furthermore, the variation in hybrid forms is significant as the nature of the hybrid structure as a ‘first-order’ control solution will likely influence the imperatives for MCS control solutions embedded within the structure. Thus, we can conceptualise the structural characteristics of inter-organisational arrangements – like the structural characteristics of traditional hierarchies – as both a *source* of management control and a *context* for management control (Fisher 1995; Flamholtz 1983, 1996; Flamholtz, Das & Tsui 1985; Merchant & Van der Stede 2007). In the remaining sub-sections below, I will examine how alternative hybrid structures influence the design and use of embedded MCS by exploring the different types of inter-dependencies between hybrid and MCS control solutions.

10.2.2. Complementary management control

The first way in which the design and use of embedded MCS is influenced by the type of hybrid structure is by attempts to ensure MCS support the functioning of alternative hybrid forms. This perspective corresponds to the ‘archetypal approach’ of conceiving hybrid-MCS relations (e.g. Kamminga & Van der Meer-Kooistra 2007; Sartorius & Kirsten 2005; Speklé 2001; Vosselman 2002), whereby MCS are shaped by the functional requirements of the hybrids’ structural characteristics.

As reported in Section 8.3, there were two patterns within the empirical material supporting the archetypal approach that MCS form a complementary relation with varying hybrid structures. First, each stand-alone case represented an internally congruent combination of control solutions, with substantial complementarity in the design of the embedded MCS to suit the characteristics of the hybrid structure. Second, there were consistent, logical cross-case patterns linking the variation of structural characteristics – centralisation, formalisation and relational governance – to differences in the design and operation of MCS.

These findings suggest that MCS operate as complements in enabling the functionality of different hybrid structures. ‘Complementary MCS’²¹³ are distinct from hybrid structural dimensions, yet their operation improves the enactment of control by the structure. They likely correspond to what Grandori and Soda (1995) describe as ‘coordinative mechanisms’; where each hybrid is distinguished by distinct mix mechanisms (Gulati & Singh 1998; Ménard 2004, 2006, 2013). Embedded MCS will vary between hybrids because they act as complements enabling the operation of different hybrid structures.

Both cross-case patterns suggest that complementary MCS will be congruent with nature of the hybrid structure. ‘Internal congruence’ is a term used in inter-organisational control research to describe the similarity of ‘patterns of control’ within an overall governance package or configuration (Johansson & Siverbo 2011), where each pattern of control manifests in the types of MCS used at different contractual phases (Donada & Nogatchewsky 2006; Langfield-Smith & Smith 2003; Van der Meer-Kooistra & Vosselman 2000).²¹⁴ Therefore, based on my empirical results I argue that complementary MCS will have internal congruence with the type of hybrid structure. That is, MCS associated with market-based patterns (e.g. competitive bidding, standardised output

²¹³ I use the term ‘complementary MCS’ as short-hand to refer to the MCS which have a complementary relation with the hybrid structure they are embedded within.

²¹⁴ For example, market-based patterns are characterised by competitive bidding selection in ex ante phase; selection based on standardised contracts; and standardised measurement and evaluation in ex post phases. In comparison, bureaucratic-based patterns are characterised by intense pre-selection of parties through detailed selection criteria and tendering processes; comprehensive contracts; and intense use of supervision, performance measurement, information exchange and direct invention ex post. Finally, trust-based or relational patterns are characterised by reliance on prior relationships or reputation for ex-ante selection; loose emergent contracts; and personal interaction, goodwill and competence trust, and social controls ex post (Van der Meer-Kooistra & Vosselman 2000).

measurement) will be used to complement market-like hybrids (e.g. subcontracting), and MCS associated with bureaucratic-based patterns (e.g. intense criteria based selection; comprehensive contracts; and intense use of supervision, performance measurement, information exchange and direct invention ex post) will be used to complement hierarchy-like hybrids.

10.2.3. Compensatory management control

The second way embedded MCS is influenced by the type of hybrid structure is through attempts to design and use MCS to safeguard for relative deficiencies or weaknesses in the control capacity of different hybrid structures. This perspective corresponds to the ‘misalignment’ approach to conceptualising hybrid-MCS relations (Anderson & Dekker 2005; Dekker 2004; Johansson & Siverbo 2011; Phua, Abernethy & Lillis 2011; Sampson 2004), where researchers expect more intense use of MCS in situations when governance structures are insufficient to address the severity of cooperation hazards.²¹⁵

As described in Section 9.3, I found that each hybrid structure appeared insufficient to address certain types of control problems and particular groups of transactions, and relied on the additional control capacity of the embedded MCS. That is, certain structural weaknesses related to particular control problems were accompanied by the relatively higher intensity use of project-level MCS – instances of transactional misalignment appeared to prompt idiosyncratic MCS responses.

These findings suggest that MCS can be used to compensate for weaknesses in a given hybrid structure. ‘Compensatory MCS’²¹⁶ are used to address the residual control problems that have not been adequately addressed, or even aggravated by the hybrid structure. In addition, the results indicate there are two different types of compensatory MCS. The first, which I label ‘standard compensatory MCS’, are used to compensate for misalignment that

²¹⁵ Based on the results of Sampson (2004), this compensating use of MCS is likely to be relatively common, particularly in inter-organisational R&D settings. The asymmetrical cost of governance structure misalignment, which indicates a substantially larger detrimental performance impact of ‘excessive bureaucracy’ compared to ‘excessive opportunism’, indicates that parties will, on balance, err on selecting a hybrid form that has too few safeguards rather than too many.

²¹⁶ I use the term ‘compensatory MCS’ as short-hand to refer to the MCS which have a compensatory relation with the hybrid structure they are embedded within.

would occur for all exchanges administered within the hybrid; and ‘idiosyncratic compensatory MCS’, which are used to compensate for the misalignment that occurs for a particular type of transaction.

Standard compensatory MCS are used to address specific cooperation control problems that are either not addressed, or perhaps even magnified by the features of the given hybrid structure. For example, hierarchy-like hybrids will use intensive monitoring and reporting systems in order to overcome ex post compliance problems that arise because of a lack of incentive intensity amongst the partners. Alternatively, market-like hybrids will rely on more extensive pre-screening and evaluation processes to compensate for the heightened risk of suboptimal selection decisions arising because of high information asymmetry. This form of standard compensatory control aligns most closely with earlier studies of misalignment (Johansson & Siverbo 2011), in that control is achieved through variation relative intensity of MCS.²¹⁷

Idiosyncratic compensatory MCS are used to address specific instances of transactional misalignment. I propose that idiosyncratic compensatory MCS will be used in relation to certain transactions whose characteristics create cooperation hazards that the standard control solutions (i.e. those used for all transactions) are insufficient to address.

This type of misalignment arises because within a given hybrid arrangement, different transactions will present with varying severity of cooperation control problems, as each transaction is characterised by different levels of asset specificity, uncertainty, information asymmetry and frequency. As hybrid structures and MCS used across all transaction types are relatively standardised and fixed, the nature and severity of misalignment may be transaction-specific. Therefore, studying arrangements with significant transactional heterogeneity using a single aggregate, average measure of transactional characteristics,

²¹⁷ This also aligns to Dekker (2004, p. 32) who identified compensatory relations between ex ante and ex post management controls. He states that ‘ex ante controls’ “mitigate control problems by aligning partners interests...before implementing the inter-organizational relationship”; however, “because ex ante formal control mechanisms are often incomplete, during the relationship unresolved control problems are managed by ex post control mechanisms that achieve control by processing information and evaluating performance” .

cooperation hazards and misalignment, will likely underestimate the absolute level of misalignment.

In addition, based on the characteristic of alternative hybrid types, we can explain why certain types of transactions were particularly problematic for each arrangement. For example, market-like hybrids are likely to be less well suited to repeated exchanges that create dependency, and hierarchy-like hybrids are likely to be less well suited to once-off exchanges with parties that are not contributors to the broader arrangement.

10.2.4. Reconciling the archetype and misalignment approaches

The empirical evidence of *both* complementary and compensatory relations between MCS and hybrid structures raises a further set of considerations about hybrid-MCS relations: how different types of interdependencies can co-exist within the same inter-organisational arrangement, and how to distinguish between alternative types of hybrid-MCS relations.

The results provide empirical support for both the archetype and misalignment approaches, suggesting that embedded MCS can be used to *both* complement and compensate hybrid structure control solutions. The empirical support for both approaches can be reconciled by recognising that while some MCS are chosen to support the strengths of a hybrid structure and some MCS are chosen to counter-balance its deficiencies, these choices do not necessarily have to involve the same MCS. Thus, these hybrid-MCS explanations are not mutually exclusive or in direct conflict with one another; instead, they complement one another, as each provides a partial explanation for why the design and operation of embedded MCS varies within alternative hybrid forms. This lends further support to the call for inter-organisational control to adopt a more ‘combinative view’ (Anderson & Dekker 2010; Caglio & Ditillo 2008): if researchers do not study the simultaneous use of MCS exercised at different organisational levels they risk capturing an incomplete selection of the inter-dependencies between control solutions, which may lead to inconsistent explanations about inter-organisational control.

The value of conceptualising alternative types of hybrid-MCS relations is conditional on our ability to differentiate complementary and (standard and idiosyncratic) compensatory MCS. I propose three ways the two types of interdependencies may be distinguished.

First, the type of MCS-hybrid interdependency is likely to vary with the relative breadth of scope (Caglio & Ditillo 2008) of the MCS. In my empirical results it appeared that complementary relations tended to exist between hybrid structure and structure-wide MCS; whereas compensatory relations existed between hybrid structure and project-level MCS. This seems logical: complementary MCS are used to support the enactment and functioning of hybrid structures, therefore they would have a similarly wide breadth of scope; and compensatory MCS are used to address structural weaknesses in relation to either particular control problems (standard compensatory) or specific sets of transactions (idiosyncratic compensatory), and will have a relatively smaller breadth of scope, targeted towards either specific contractual phases or specific transactions.

Second, the type of MCS-hybrid interdependency is likely to vary by the degree to which the focal MCS is internally congruent with the overall ‘governance package’ (Johansson & Siverbo 2011). As complementary MCS support the enactment of the hybrid structural characteristics they will tend to form part of congruent ‘patterns of control’ (Van der Meer-Kooistra & Vosselman 2000) in relation to the type of hybrid structure. For example, competitive bidding practices will be used to complement market-like hybrids such as subcontracting arrangements. In comparison, because compensatory MCS are used to counter-balance the control deficiencies of the structure, they will likely involve MCS associated with different patterns of control. For example, highly interactive, relational-based project negotiation processes will be used to compensate negotiation control problems in market-like hybrids.

Third, different MCS-hybrid interdependencies will manifest in different cross-sectional patterns between or within alternative hybrid types. As complementary MCS are unlikely to provide any independent control capacity in addressing control problems, they can be identified as embedded MCS that vary with structural characteristics, but are only indirectly related to antecedent characteristics.²¹⁸ Standard compensatory MCS, like complementary MCS, will tend to be used consistently across all exchanges embedded within a particular hybrid, and likewise will vary with structural characteristics. However, as each hybrid

²¹⁸ It is expected that the relation between transactional characteristics and complementary MCS is mediated by hybrid governance dimensions.

arrangement has varying capacities and deficiencies in relation to *different* cooperation control problems, the use of standard compensatory MCS will emerge in within-case variation in the use of MCS at different contractual phases. Furthermore, as different types of hybrids will rely on compensatory MCS for different types of control problems, we can also identify standard compensatory MCS in between-case variation in the patterns of MCS use across contractual phases. Finally, as idiosyncratic compensatory MCS are only used in relation to specific subsets of transactions, they can be identified by examining within-case variation of the association between embedded MCS and individual transactions' characteristics.

10.3. Relating control problems and control solutions

In this section I consider the issue of how control problems and control solutions relate. This issue shifts attention away from trying to understand *what types* of control solutions are used in particular contexts, and instead towards explaining *how* and *why* control solutions are designed and used. This extends management control research by providing a more nuanced explication of the constructs and logic of control problems and control solutions, which is a style of theorising being widely adopted by accounting researchers. Control problems and solutions have been used frequently as a way of explaining the design and use of MCS within inter-organisational settings (Birnberg 1998; Caglio & Ditillo 2008; Dekker 2003, 2004, 2008; Gulati & Singh 1998; Neumann 2010; Nicholson, Jones & Espenlaub 2006); however, they can also be applied to theorise why MCS are used within organisational settings more generally.²¹⁹

I will explore the relation between control problems and control solutions in three stages. First, in Section 10.3.1, I conceptualise the control problem/control solution dynamic in general to explain how and why control solutions align to control problems. Second, in Section 10.3.2, I apply this general explanation to develop a model depicting why different control solutions are used to address cooperation control problems in inter-organisational

²¹⁹ For example, in traditional intra-organisational settings, researchers have considered how the design and use of MCS is shaped by a general control problem of how to influence organisational actors, who may have their own divergent interests, to behave in ways which align or contribute to the achievement of an organisation's goal, i.e. how to achieve goal congruent behaviour (e.g. Czarniawska-Joerges 1988; Flamholtz, Das & Tsui 1985; Malmi & Brown 2008; Merchant & Van der Stede 2007; Otley 1994).

R&D. Finally, in Section 10.3.2, I explore the contexts where the relation between control problems and solutions are not expected to hold and to explain why misalignment between cooperation control problems and solutions occurs.

10.3.1. Conceptualising the control problem/control solution dynamic

Within management control research, ‘control problems’ and ‘control solutions’²²⁰ have been used to explain why MCS are selected, designed and operated within specific organisational contexts. This style of theorising is characterised as a rationalist approach to control, where researchers assume an instrumental relation between control problems arising out of context-specific antecedent factors and the control solutions designed to address those problems (Vosselman & Meer-Kooistra 2009). Researchers have applied this logic in empirical studies to show that the choice of control solutions is determined by the category of control problems (e.g. Dekker 2003, 2004, 2008; Gulati & Singh 1998; Tomkins 2001); the specific type of control problems (e.g. Neumann 2010); and the severity or magnitude of control problems (e.g. Anderson & Dekker 2005; Dekker 2008; Johansson & Siverbo 2011).

Our understanding of the relation between control problems and solutions can be extended by examining the nature of the control problem construct more closely. A ‘control problem’ is an analytical label used to describe the contextual imperatives for “why observed control patterns or control structures exist” (Vosselman 2012, p.5).²²¹ Researchers’ use of this label varies, ranging from highly formulated conceptions designed to be measured empirically (e.g. Dekker 2008; Johansson & Siverbo 2011), to more loosely defined descriptions of the expected role of MCS (e.g. control problems of intra-firm transfers in Spicer 1988; subcontractor control problem in Gietzmann 1996).

However, as I encountered during the collection and analysis of data, in reality control problems are not necessarily exogenous, readily observable phenomenon in organisational

²²⁰ The actual use of these labels varies. For example, control problems have been described as ‘control concerns’ or ‘control considerations’; ‘control solutions’ have often been referred to simply in terms of ‘control structures’, ‘control systems’ or ‘control responses’.

²²¹ In comparison, control solutions are observable stable control structures (Vosselman 2012).

settings, which are easily separable from control solutions they supposedly explain. Instead I found that control problems could often only be detected through convergent symptoms such as managerial accounts for using particular control structures or mechanisms, the presence of certain antecedent factors, and patterns in the types of transactions that received particular managerial attention. These observations correspond to Vosselman's (2012, p.8) depiction of a control problem as "the problem behind the solution".

The difficulty in observing control problems in practice is not, however, conclusive evidence that they do not exist; rather, it seems more likely that control problems are less salient and less separable from control solutions whenever problems and solutions align in a state of resolution (at least temporarily). At any given point in time, the prevalence of resolved control problems (and relative lack of unresolved control problems) occurs because managers are not simply reactive agents, waiting for control problems to arise. Instead, contingent on their experience and foresight, managers anticipate control problems and proactively design control solutions in advance (Neumann 2010). These control solutions may *operate* at different points in time: for example, some may operate *ex post* and manage problems as they arise, such as by providing a procedure for identifying and rectifying issues, or stipulating provisions for remedy or recourse; alternatively, they may operate *ex ante* to mitigate control problems, such as by reducing the risk of problems occurring in the first place (Dekker 2004, 2008). However, both *ex ante* and *ex post* MCS can be *designed ex ante* (Neumann 2010).

Therefore, rather than viewing control solutions as determined by control problems, it is more useful to portray control solutions as determined by the *potential* for control problems (Dekker 2008; Nicholson, Jones & Espenlaub 2006). I define the 'control problem potential' as the perceived risk of hazards occurring given the antecedent characteristics of a given control situation.²²² Furthermore, depending on the ability of the manager to correctly anticipate and prepare for these risks, the control problem potential may remain latent (i.e. resolved problem) or may become realised (i.e. unresolved).

²²² A control situation refers to a given domain of management control, which varies by the antecedent characteristics. For example, in this study the relevant control situation were different types of transactions. This could also refer to different sets of activities, tasks, work groups, organisational units.

A further consideration relates to the interactivity between the potential for control problems and the successive control solution choices. This issue emerges when we recognise that a single control (potential) problem is often addressed by multiple control mechanisms (Brown, Malmi & Booth 2014; Flamholtz 1983; Flamholtz, Das & Tsui 1985; Malmi & Brown 2008; Otley 1980). This aligns to previous conceptual work, such as the multi-level model of inter-firm control solutions and problems developed by Caglio and Ditillo (2008), who argue that a focal control problem is addressed by a combination of cost and accounting techniques, MCS, and control archetypes. Similarly, Johansson and Siverbo (2011, p. 294) advocate for a taxonomic configuration approach, arguing that suppliers are governed by several different types of controls simultaneously, which “interconnect to form distinct configurations or effective wholes”. This perspective also corresponds to the wealth of empirical studies examining the use of multiple control systems – for example, the majority of the studies listed in Appendix A investigate multiple strategies and techniques parties use to manage inter-firm cooperation control problems.

Crucially, control solution choices are not all made simultaneously at a single point in time. For instance, in reference specifically to cooperation control problems, authors argue that governance structure and partner selection often precede the choice of MCS (Dekker 2008; Johansson & Siverbo 2011; Van der Meer-Kooistra & Vosselman 2000); that *ex ante* control choices are exercised prior to the development of *ex post* control (Dekker 2004; Neumann 2010); or that control designs emerge and change during the course of a transacting relationship (Kamminga & Van der Meer-Kooistra 2007; Langfield-Smith 2008; Langfield-Smith & Smith 2003; Van der Meer-Kooistra & Vosselman 2000).

Likewise, in my case results, some control elements, such as the design of the hybrid structures, predated the design of other control solutions, such as the latter development of strategic planning processes or introduction of new project management procedures. Significantly, it appeared these subsequent control choices were influenced, not only by the underlying control problems, but also by the design and operation of existing control structures and systems (e.g. Grabner & Moers 2013). As discussed in Chapters 8 and 9, the design of some embedded MCS appeared driven by the need to enhance and enact the varying structural characteristics of the hybrid arrangements (see Section 8.3), while other

MCS were used to compensate for weaknesses in the hybrids' ability to cope with particular types of control problems or particular sets of transactions (see Section 9.3).

The inter-dependence between successive control solution choices is not explicitly articulated in conceptual frameworks or modelled in empirical studies that assume that alternative control solutions are determined by the same underlying control problem. Furthermore, while authors, such as Johansson and Siverbo (2011) argue that the design of control system combinations is driven by the need to achieve both an 'external' fit with the surrounding context and 'internal' fit between the control systems, it is not clear how this 'fit' is achieved.

Therefore, I propose that each control solution choice is determined by the adequacy of existing control solution choices in addressing the potential for control problems. This adequacy can be captured by a construct I label as '*the residual control problem potential*', which is the result of the interaction between the antecedent contextual factors – which combine to determine the severity of risk that a particular type of control problem could occur – and existing control solutions.²²³ If there are no existing control choices (e.g. in an initial decision about the nature of the hybrid arrangement, or the set-up of MCS in a new venture), the residual will simply equal the general latent control problem potential.

Following a rationalist, efficiency-seeking logic, ideally each successive control solution choice leads to a reduced residual control problem potential until either the residual control problem potential reaches zero, or all control choices have been exhausted and all that remains is a residual control loss.²²⁴

However, successive control solution choices may not lead to a monotonic decreasing pattern of residual control problem potential, as control solutions may not always reduce control problems severity. Control solutions may also *change the nature* of the potential control problems by altering the characteristics of antecedent characteristics (i.e. alter the quality of the residual control problem potential). For example, monitoring devices may

²²³ This interaction corresponds to the use of moderating variables to model the relation between control problems and solutions; e.g. partner selection and governance (contract) extensiveness in Dekker (2008).

²²⁴ This is akin to the 'residual loss' in agency theory (Jensen & Meckling 1976).

reduce the level of information asymmetry, but not the asset specificity, thereby reducing the scope for misrepresentation but not the potential for opportunistic hold-up (Neumann 2010). In addition, control choices may also *exacerbate or intensify* the potential for control problems (i.e. creating a larger, more severe residual control problem potential). For example, high centralisation of investment decisions may increase information asymmetry and thereby increase the opportunity for misrepresentation; or finite contractual agreements increase time-pressure, thereby reducing the tolerance for ex post variability and exposing parties to a heightened risk of hold-up.²²⁵ Thus, the relation between the potential for control problems and the design of control solution choices is likely to be dynamic, variable and interactive over time.

This explanation – that each separable control solution choice will be determined by the nature and severity of residual control problem potential – provides a way of conceiving control system design that accommodates the existence of multiple control solutions, without presuming a singular holistic design. Instead, the design and use of MCS is presented as an emergent ongoing process, where managers anticipate likely control risks and experiment with different combinations of control solutions (although managers' ability to experiment will be limited in relation to governance structure choice and structure-wide MCS, and will likely focus on idiosyncratic MCS). Furthermore, this explanation can be adapted to describe the determinants of control solutions with either complementary or compensatory relations to pre-existing control structures. For example, complementary control choices will be exercised to reduce residual control problem potential by enhancing and enacting the control capacities of existing control structures or systems; whereas compensatory control choices will be exercised to reduce residual control problem potential by counterbalancing the weaknesses of existing control structures or systems.

In the following section I will apply this general explanation to the specific domain investigated in this thesis to show how this relation between separable control solution

²²⁵ This is likely to occur in organisational settings with multiple or overlapping control problems; where the use of one control solution may be aligned to address the needs of one particular control issue, but may inadvertently increase the potential for other issues to occur.

choices and residual control problem potential explains the design and use of combinations of hybrid structures and MCS in inter-organisation R&D arrangements.

10.3.2. Managing cooperation control problems in inter-organisational R&D

The second stage of exploring how control problems and solutions relate is to explain the management control of cooperation control problems in inter-organisational R&D exchanges. I combine the logic developed in the previous section with the specific elements investigated in this thesis to develop a model depicting the dynamic relation between cooperation control problems and control solutions in inter-organisational R&D exchanges (see Figure 18). This illustrates how the general explanation of the determination of successive control choices explains the empirical patterns of interdependent control choices I observed within the two case studies.

In this study I have examined how parties in inter-organisational R&D exchanges respond to cooperation control problems arising out of transactional and behavioural antecedent characteristics at ex ante, contract and ex post contractual phases. The potential for each of these control problems arises out of a combination of asset specificity, uncertainty and information asymmetry and frequency. Responding to calls for a more ‘combinative view’ of control solutions (Caglio & Ditillo 2008), I studied the type and structure of hybrid governance as well as various forms of embedded MCS.

When we apply the proposition that each successive control choice is determined by a residual control problem potential, a pattern emerges describing how combinations of control solutions develop in response to a changing control problem potential.²²⁶ This pattern, which is depicted in Figure 18 is interactive and iterative, showing how control solution choices are determined by the product of both latent hazards produced by antecedent characteristics, as well as the control solving capacity of existing control structures and mechanisms.

²²⁶ This interaction occurs separately for each cooperation control problem.

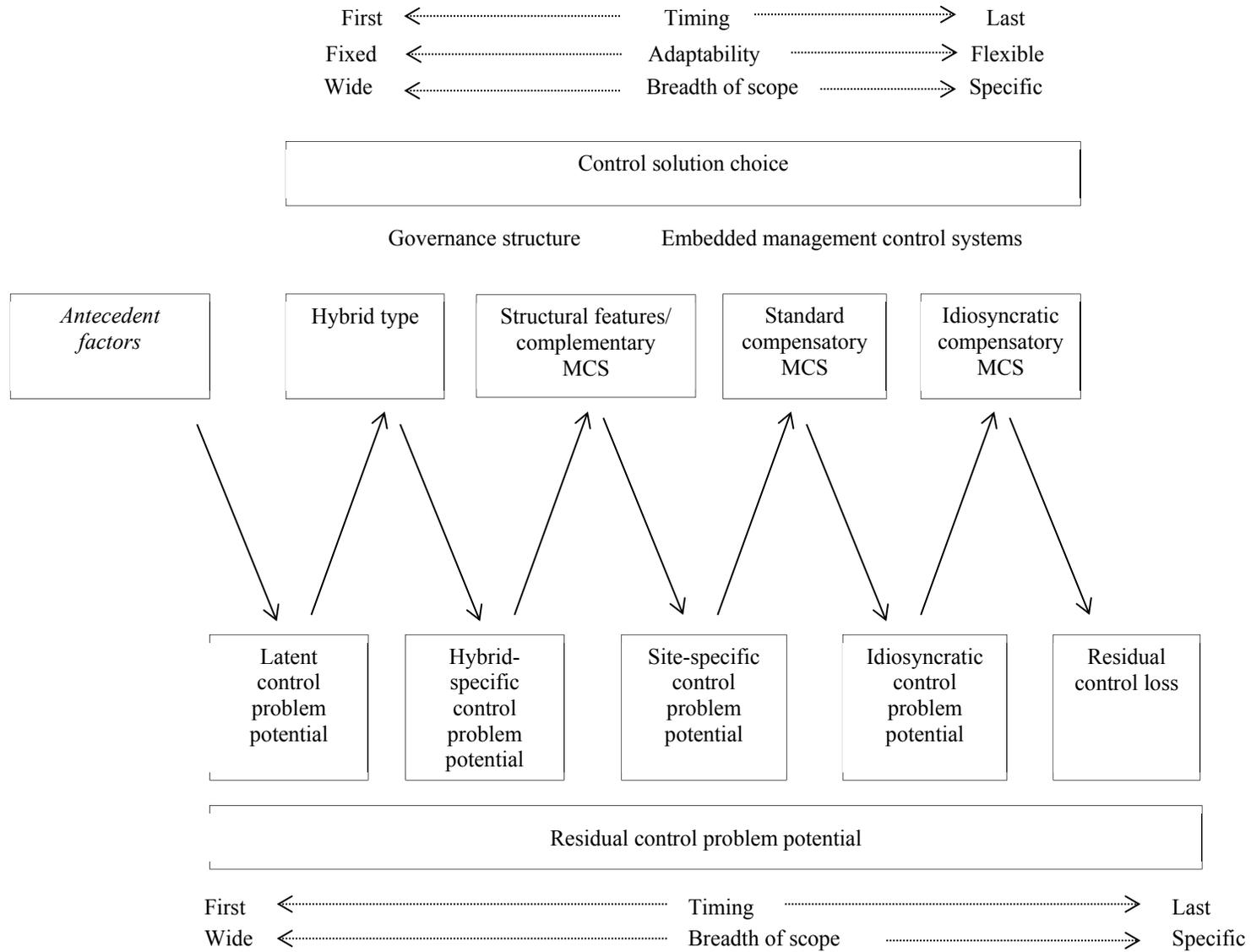


Figure 18: Conceptualising the dynamic between control problems and solutions in inter-organisational settings

As each successive control solution choice is affected by the adequacy of pre-existing control solutions, the sequencing of control solution choices is significant. I have sequenced control solutions according to a similar order to the extended make-or-buy decision (Dekker 2008; Johansson & Siverbo 2011; Van der Meer-Kooistra & Vosselman 2000). Moving left to right across the top of the figure, this sequence starts with the type of hybrid arrangement; then the configuration of structural dimensions and complementary MCS; followed by standard compensatory MCS, which apply across the entire arrangement; and finally, the idiosyncratic compensatory MCS, which apply to only a subset of activities or transactions. Although in practice these decisions may be made simultaneously or in a different order, this sequencing appears appropriate, at least analytically, for four inter-related reasons.

First, this sequence corresponds to the temporal order assigned to control choices in the existing inter-firm literature, where authors have argued that parties first decide upon an appropriate governance structure, followed by the design of the embedded MCS (Dekker 2008; Johansson & Siverbo 2011; Van der Meer-Kooistra & Vosselman 2000).

Second, the sequence corresponds to the timing of control solution design and implementation observed empirically within the two case studies. In both arrangements the hybrid type, structural characteristics (e.g. formalisation, centralisation), and some structure-wide MCS, were pre-determined by legislation; parties subsequently developed or modified other MCS over time. The most recent additions to the control configurations, in both cases, were idiosyncratic adjustments to project-level MCS for specific sets of transactions.

Third, this sequencing also aligns to the relative ease or flexibility parties have to adapt or modify different control choices. The design of the structural characteristics of inter-firm arrangements is relatively fixed; once implemented it is difficult and costly for structural characteristics to be changed.²²⁷ In comparison, it is easier to modify the MCS used within

²²⁷ For example, changing the associational formalisation requires formal renegotiation of the contracts between parties. Also, a change in hybrid structure is likely to require further adjustment of related MCS.

inter-firm arrangements, particularly the types of MCS that relate to specific project-management phases or only a subset of transactions.

Finally, the sequence also corresponds to differences in the relative breadths of scope of controls (e.g. in Anderson & Dekker 2010; Caglio & Ditillo 2008). Choices about control solutions with broader breadths of scope, such as structural decisions affecting all transactions and activities within the arrangement, are likely to occur first, followed by decisions about controls affecting all transactions but perhaps only for a certain time period or contracting phase, and finally choices about transaction-specific control arrangements. Subsequent control choices are likely to have smaller breadths of scope to enable an efficient ‘building up’ of control solutions; if later choices have larger scopes, they ostensibly replace earlier control choices.

Furthermore, this sequencing of control choices aligns the breadth of scope of control solutions to the relative breadth of the residual control problem potential, which on average will become more specific after the intervention of successive control choices. Moving left to right across the bottom of the figure, these include: the latent control problem potential, which arises out of the antecedent characteristics; the hybrid-specific control problem potential, which accounts for the relative strengths and weakness of different hybrid types; the site-specific control problem potential, which accounts for operation of the specific combination of structural features and complementary MCS used within the arrangement; idiosyncratic control problem potential, which remains after the implementation of standard compensatory MCS; and finally ‘residual control loss’, which represents the remaining misalignment after idiosyncratic MCS responses have been applied.²²⁸

This sequence, which matches the breadth of scope and adaptability of successive control solution choices with the breadth of scope of residual control problems, not only

²²⁸ This sequencing of control solution choices also makes it possible to accommodate the different types of inter-dependencies between control solutions observed in this study, including complementary relations, standard compensatory relations, and idiosyncratic compensatory relations. Logically, compensatory MCS – the systems and devices used to address weaknesses in existing control solutions – are likely to be developed after the implementation of complementary MCS. In addition, standard compensatory controls – which apply across all transaction types, but for specific contracting phases – will precede idiosyncratic compensatory control choices developed to address transaction-specific problems.

corresponds to the timing of choices described in the literature and observed in this study; it also appears to maximise efficiency of control solution/problem alignment. This is because this sequence creates a ‘triage’ process towards potential control problems: where each incremental control solution builds on existing control solutions to match the marginal residual control issues. These incremental control capacities are only applied to specific contractual situations as required.

Thus, in summary, Figure 18 appears to provide a logical, coherent depiction of how combinations of control solutions may be developed to address cooperation control problems in inter-organisational settings. It also appears consistent with the patterns of interdependent control choices I found in each case. In particular, Figure 16 and Figure 17 in Chapter 9 describe the observable result of control solution choices in relation to each cooperation control problem; the constructs and interactions illustrate the underlying, possibly unobservable processes that lead to these combinations of control solutions.

10.3.3. Accepting residual loss: understanding the bounds of efficient alignment

The final consideration, about how control solutions and problems relate, concerns the circumstances in which we would not expect the relation between control problems and solutions to hold. To address this issue I focus on the occurrence of misalignment between cooperation control problems and solutions, which is represented in Figure 18 by the residual control loss. Although my starting assumption was that managers possess an unconstrained ability to alter hybrid and MCS configurations to minimise residual loss, this would imply, rather unrealistically, that misalignment would never occur in practice. Therefore, in this section I aim to explain the occurrence of misalignment by considering why managers would accept a residual loss greater than zero.

There are several likely reasons why managers would accept a residual loss greater than zero. Some of these reasons require an adjustment of our underlying assumptions about managerial decision-making, such as their rationality or motives for designing and using

MCS.²²⁹ In this section I explore a set of reasons that continue to assume that boundedly rational, far-sighted managers, make control choices to maximise the efficiency and effectiveness of the control solutions in relation to cooperation control hazards.

This line of reasoning develops from my observations about a certain type of misalignment that occurs in relation to subsets of transactions within inter-firm arrangements. In both the cases I studied, managers were confronted with particular sets of transactions²³⁰ that were not well suited to existing control structures. Although these instances of misalignment were eventually addressed by idiosyncratic compensatory control responses, they persisted within each of the arrangements for several years.²³¹

These examples of transactional misalignment may have been caused simply by a lack of managerial awareness about either the nature of control problems for these subsets of transactions, or about what would be an appropriate control solution response. For example, Sampson (2004) argues that misalignment occurs because decision-makers do not fully anticipate contractual hazards, because they rely on heuristics that are subject to bias, or because hubris or overconfidence leads them to overestimate their ability to handle contractual hazards. This would suggest that misalignment is simply a temporal artefact: caused by managers' bounded rationality in the short-term, but eventually corrected by competitive pressures towards equilibrium in the long-term (Williamson 1985, 1996).

However, I propose that this type of transaction-specific misalignment may also occur because of considerations for the broader portfolio that transactions exist within. That is, I posit that managers of arrangements with multiple transactions will intentionally accept a residual control loss greater than zero as a result of a trade-off between the benefits of

²²⁹ For example, an alternative explanation about why managers may accept a residual loss could concern the need to ensure organisational survival by conforming to broader institutional expectations about what types of control systems and structures to use (Dimaggio & Powell 1983; Meyer & Rowan 1977). Alternatively, Johansson and Siverbo (2011, p. 297) argue that "misalignment may result because of, for example, lack of information, misunderstandings, or purely random choices...for ideological and political reasons...or as a consequence of different forms of institutional pressures, i.e. forced selection, fad and fashion". Such explanations hold different assumptions about the nature and criteria for control choices.

²³⁰ In the Cotton CRC, misalignment occurred with transactions with non-party providers; in the CRDC, misalignment appeared to occur in transactions with highly specialised 'core' providers.

²³¹ In addition, in the case of the CRDC it is not clear whether in fact these issues have been completely resolved by the use of idiosyncratic control responses.

modifying control solutions to achieve alignment for an individual or subset of transactions²³², versus the costs or negative impacts that are borne at a portfolio or aggregate level. Furthermore, this type of portfolio trade-off may occur for three different reasons: relative cost efficiency, internal congruence, and equity concerns.

Relative cost efficiency of adjusting control

First, managers will not alter control arrangements when the incremental benefit of achieving transaction-level alignment does not outweigh the cost of modifying existing control arrangements. This aligns with TCE's central premise – the efficient alignment hypothesis – that modifications of governance will only be made so long as the cost of misalignment outweighs the additional cost of governance (Williamson 1985).

Changing existing control solutions introduces a switching cost, and if the switching costs to establish alternative control structures are high, “it may be more efficient for firms to continue to use extant governance structures that are not optimal” (Phua, Abernethy & Lillis 2011, p.1798). These switching costs comprise of two components: the incremental investment cost of creating new control structures; and the opportunity cost of the benefits forgone when discarding or altering existing controls (Phua, Abernethy & Lillis 2011). For example, in implementing idiosyncratic control structures, managers may be required to sacrifice the benefits of having standardised control responses, such as economies of scale and comparability in planning, evaluation and monitoring. Alternatively, adjusting broader control structures may potentially increase the residual control problem potential of other types of transactions. This corresponds to Williamson's ‘criterion of remediableness’ – described as TCE theory's ‘reality check’ for its application to practice –which implies that you cannot compare an extant organisation with one de novo, without also including in the analysis the switching/implementation costs of changing modes of governance in the analysis (Tadelis & Williamson 2013; Williamson 1996, 2010).²³³

²³² I use the term transaction because of the framing of this study; however, the same set of arguments could apply to other units of organisational activity, such as tasks, projects or work groups.

²³³ The remediableness criterion is that “an existing mode of organization for which no superior feasible form of organization can be described and implemented with expected net gains is presumed to be efficient”

Therefore, as a result of an economic trade-off between the cost of misalignment for a given transaction (or subset of transactions) and the switching cost of altering the existing control choice combinations, it may be more cost-efficient overall for a manager to accept a level of residual loss for the transaction (or subset of transactions).

Internal congruence of ‘governance packages’

Second, managers will not alter control arrangements if the requisite control solutions compromise the internal congruence of the entire configuration of control. This aligns with TCE theory’s view of governance modes as discrete structural alternatives; each stable pure form relies on a distinct, complementary combination of coordinative mechanisms, administrative controls, incentive intensity, and contract law regimes (Williamson 1985, 1991). Furthermore, one of the TCE’s follow-on implications is the ‘impossibility of selective intervention’ – that it is impossible to combine the good attributes of different forms of governance, or to alternate between them as desired (Williamson 1985). Alternative governance forms differ in “discrete structural ways and we need to come to terms with the strengths and weaknesses of each” (Williamson 2010, p. 683).

The study by Johansson and Siverbo (2011) demonstrates the importance of developing internally consistent governance packages or ‘internal fit’ in management control patterns. They find that organisations experience dysfunctional contractual outcomes as a result of incongruence in the overall patterns of control. For example, they observe that outsourcers create ‘mixed messages’ when relying on both trust-based control and market orientation in contracting phases:

The buyers seem to simultaneously treat the suppliers as benevolent trusted partners and as self-seeking opportunistic actors. This creates an ambivalent stance in the middle between a market oriented and trust-oriented approach to controlling suppliers. (Johansson & Siverbo 2011, p.306)

In addition, they argue that incongruence can occur when relying on different forms of controls at different contracting phases. For example, in situations where buyers have

(Williamson 2010, p. 683). The inclusion of the terms feasibility and implementation is a hallmark of TCE’s roots in rejecting any notion of efficiency based on zero transaction costs (Williamson 2010).

traditionally relied on relational governance, an excessive use of results and action control can create self-fulfilling perceptions of low trust between the parties.

Therefore, managers may accept a residual loss for a given transaction (or subset of transactions) if the incremental control solution required to achieve alignment is incongruent with the pre-existing combination of control solutions.

Preserving a sense of equity

A final reason why managers may not alter control arrangements is to preserve a sense of equity in the management of alternative suppliers. That is, managers may hesitate in implementing transaction-specific control solutions that are perceived as preferential towards a particular supplier, as this could disrupt the contractual relations they share with other suppliers who do not receive the same terms or conditions. This seems particularly important in hybrid settings, as Williamson (1991) argues that in the absence of managerial fiat, often hybrid exchanges are controlled through the mutual consent and collaborative spirit of parties, rather than the unilateral decision-making found in markets or coercive or authority command found in hierarchies.

However, the need to preserve a sense of equity in the management of alternative suppliers appears to be at odds with the use of supplier segmentation strategies observed in previous studies (e.g. Cooper & Slagmulder 2004; Gietzmann 1996; Mouritsen, Hansen & Hansen 2001). These studies report that focal firms are able to achieve effective management control outcomes by dividing suppliers into different categories and using different control approaches for each. For example, Gietzmann (1996) describes how Japanese auto sub-assemblers segment their suppliers into three categories: suppliers with whom they have one-off transactions; marginal suppliers, used as capacity buffers for production tasks; and finally, a selection of suppliers of design work, with whom the assembler sought to build long-term relations subject to repeated appraisal. Gietzmann argues this supplier segmentation strategy addresses opportunism by enabling assemblers to use different control strategies for different suppliers (e.g. more intensive, yet informal information exchange for long-term suppliers) and by creating promotion incentives and competition

between suppliers vying to become a 'preferred' long term supplier (Gietzmann & Larsen 1998).

These observations of effective supplier segmentation strategies provide an indication of when preserving a sense of equity may be less or more important. Cooper and Slagmulder (2004), Gietzmann (1996) and Mouritsen, Hansen and Hansen (2001) were all based on cases involving centralised subcontracting arrangements. In all three cases, while relational contracting existed between the focal firm and the supplying parties, there was no need for relational ties *between* suppliers that could be compromised by perceptions of preferential treatment. This would indicate that the use of standardised control responses and the maintenance of supplier-perceived equity will be more important in situations where an inter-organisational arrangement relies upon lateral relational ties between suppliers, for example in more collaborative arrangements such as joint ventures or inter-firm networks.

Therefore, managers may elect to accept residual loss in order to maintain standardised control responses and preserve a sense of equity amongst a portfolio of supplying firms, particularly in arrangements that involve lateral relations between suppliers.

10.4. Chapter summary

This chapter explored the broader theoretical implications for understanding the relations between different types of inter-dependent control solutions, and the relation between control problems and control solutions.

In Section 10.2 I examined the nature of the interdependencies between different types of control solutions, by explaining how and why variation in hybrid structures influences the design and use of embedded MCS. At the core of the argument, I propose that different hybrid types, characterised by different structural dimensions, have different structural capacities to address cooperation control problems. This varying structural control capacity explains how alternative hybrid forms act as a 'first-order' control solution, and why embedded MCS vary between alternative hybrid arrangements. Some MCS are used to complement the control capacity of different hybrid structures, and some MCS are used to compensate for hybrid structures' control deficiencies. Furthermore, it is possible to further differentiate compensatory hybrid-MCS relations into two types: standard compensatory

MCS, which are used across all transactions to address the misalignment between a given hybrid structure and a specific type of *control problem*; and idiosyncratic MCS responses, which are used to address the misalignment between a given hybrid structure and a specific type of *transaction*. Within a given inter-organisational arrangement these types of hybrid-MCS interdependencies may co-exist. We can differentiate these interdependencies by the focal MCS' breath of scope, internal congruence in the pattern of control with the hybrid structure, association with hybrid structure, and transactional characteristics.

The second relation I explore is between control problems and control solutions more generally. This issue was examined in Section 10.3 in three stages. First I conceptualised the control problem/control solution dynamic in general, to propose that each successive control solution choice is determined by the adequacy of existing control solution choices in addressing the potential for control problems. I then applied this general explanation to the specific domain investigated in this thesis to show how this relation between separable control solution choices and residual control problems explains the design and use of combinations of hybrid structures and MCS in inter-organisation R&D arrangements. Finally, I explored the circumstances in which we would *not* expect the relation between control problems and solutions to hold. Based on empirically observed occurrences of transactional misalignment, I propose three reasons why managers of arrangements with multiple transactions would accept a residual control loss greater than zero. These three reasons – cost-efficiency, internal congruence, equity – each potentially explain why a manager would trade-off the benefits achieving alignment for an individual or subset of transactions to avoid the costs or negative impacts that are borne at a portfolio or aggregate level.

Both these two sets of explanations provide implications for future research and for practice. In the following and final chapter, which provides an overview of the thesis and identifies limitations of the study, I will suggest how these issues may be extended in future studies and translated into managerial practice.

Chapter 11: Conclusion

11.1. Introduction

In this thesis I have studied and analysed two case studies in order to understand how parties who engage in inter-organisational R&D exchanges address cooperation control problems through hybrid governance structures and MCS. The aim of this final chapter is to bring the different lines of inquiry within the thesis to a close and place the work in the context of broader research and practice. Thus in Section 11.2 I summarise the thesis contributions and explicate the implications for future research and practice. In Section 11.3 I then in discuss how the study's limitations shape the interpretation of its results before offering some concluding remarks in Section 11.4.

11.2. Thesis summary

The central research question I explored in this thesis is: how are cooperation control problems, which arise in inter-organisational R&D exchanges, addressed by the control solutions of hybrid structures and embedded management control systems? My investigation of this question was prompted by changes in current business practices that have been largely unaccounted for by prior research. That is, while the vast majority of prior literature about the management of R&D is premised upon a vertical integration model of R&D (Chesbrough, Vanhaverbeke & West 2006); increasingly firms are turning to external contracting modes to satisfy their technological development needs (Chesbrough, Vanhaverbeke & West 2006; Chesbrough 2003a, 2003b; Ding, Dekker & Groot 2010; Hagedoorn 2002; Powell & Grodal 2005; Powell, Koput & Smith-Doerr 1996).

Exploring this question also presented an opportunity to extend upon two relevant, but separate bodies of management accounting literature. The first is a collection of empirical studies that have examined how MCS are used within inter-organisational R&D arrangements (Dekker 2004; Gietzmann 1996; Gietzmann & Larsen 1998; Miller, Moll & O'Leary 2012; Miller & O'Leary 2005a; Miller & O'Leary 2005b; Miller & O'Leary 2007; Mouritsen, Hansen & Hansen 2001; Revellino & Mouritsen 2009). Although these studies

show the relevance of control mechanisms in managing firms' coordinative requirements and appropriation concerns, it remained unclear the extent to which these MCS, or others, are also used in relation to managing cooperation control problems. The second body of literature concerns the broader agenda of understanding the management control of cooperation issues in inter-firm environments (Anderson & Dekker 2010; Caglio & Ditillo 2008; Håkansson, Kraus & Lind 2010; Håkansson & Lind 2006; Meira et al. 2010; Van der Meer-Kooistra & Vosselman 2006; Vosselman 2012). Framed by theory from TCE, these studies demonstrate the relevance of governance structures and MCS in addressing cooperation control problems in inter-firm settings; however, they lack consistency in conceptualising control solutions, particularly in terms of the capacity of different types of hybrid arrangements, and their interdependencies with MCS control solutions.

Building on these two literatures I developed a conceptual framework in Chapters 2, 3 and 4, proposing the possible nature and relation between three potential cooperation control problems and control solutions in inter-organisational R&D exchanges. To explore the validity of this framework I conducted two qualitative case studies of inter-organisational R&D arrangements in the Australian cotton industry, which are described in Chapters 6 and 7. I then analysed and compared the two cases in Chapter 8, using my conceptual framework to categorise each arrangement's structural characteristics and MCS, and to identify patterns describing interdependencies between control solutions. Then in Chapter 9 I analysed the material for patterns between control solutions and cooperation control problems. On the basis of this analysis, in Chapter 10 I proposed the broader theoretical implications of the study's empirical results, concerning the relations between inter-dependent control solutions, and the relations between control problems and control solutions.

Throughout my investigation I have explored three inter-related lines of inquiry: the nature of cooperation problems in inter-organisational R&D exchanges; the design and operation of different types of hybrid structures and MCS control solutions, and the nature of interdependencies between them; and the relation between control problems and control solutions. In the following subsections, I will summarise the study's findings in relation to each of these three issues, and outline the implications for future research and for practice.

11.2.1. Cooperation control problems

The first contribution of this thesis is the conceptualisation of three cooperation control problems in shaping the design and operation of control structures and mechanisms in inter-organisational R&D exchanges. This provides a different rationale for the design and use of control structures and mechanisms in inter-organisational R&D, compared to previous accounts which describe the capacity of MCS to address coordination or appropriation concerns. Also, the decomposition of cooperation control problems into three specific types occurring at three different contractual phases extends the work of Neumann (2010), by providing further support for the idea that different opportunism risks give rise to different types of cooperation problems, which in turn necessitate the use of alternative control strategies at ex ante, contract and ex post stages of exchanges.

The framing of three cooperation control problems was accomplished in Chapter 2 by applying TCE theory to R&D characteristics within a three-phase model of a transactional relation (Van der Meer-Kooistra & Vosselman 2000). The resulting three cooperation control problems were conceptualised as: the risk of costly setup and negotiation of projects because of dependence on specialised providers (ex ante); the risk of poor project investment decisions due to supplier misrepresentation of their capabilities or the parameters of the project (at the point of contract); and the difficulty in evaluating and enforcing contract compliance (ex post).

To confirm the validity of my framing of cooperation control problems, I examined patterns in the first-hand accounts of parties on different sides of R&D exchanges within two different inter-organisational arrangements. The results, presented in Chapter 9, confirmed the existence of problems at the negotiation, selection and execution phases of R&D contracts, arising out of a range of perceived risks that research providers or research funders, could behave in self-interested ways.

The conceptual value of decomposing the category of cooperation control problems into three different types is that it reveals much more nuanced relations between inter-dependent control solutions, and between control problems and control solutions. Within a given inter-organisational arrangement, the imperative for hybrid structure and MCS control solutions

cannot be reduced to a single, aggregate risk of opportunistic behaviour; rather, different combinations of control solutions are required to address the risk of different forms of opportunistic behaviours that arise at different contractual phases.

Implications for future research and for practice

There exists opportunity for future research to use the three-phase model of cooperation control problems to more finely map the relations between different types of opportunism, control problems and control solutions in other inter-organisational settings. As previous researchers have categorised control solutions using the same three phases, studies could investigate to what extent the categorisation of cooperation control problems corresponds to control solutions at ex ante, contract and ex post stages of transactions. Also, the results provide some preliminary indication that in practice, the three problems may not be independent, with particular sets of transactions appearing to cause more severe problems at all three contracting phases. Thus, future studies could examine transaction-level data to examine the relation and interdependence between control problems at different phases.

In addition, the problematisation of cooperation issues differs from previous contributions concerning coordination and appropriation control problems in inter-organisational R&D (e.g. Dekker 2004; Gulati & Singh 1998; Miller & O'Leary 2005a; Miller & O'Leary 2007; Mouritsen, Hansen & Hansen 2001; Revellino & Mouritsen 2009). It appears one possible way of distinguishing between these three imperatives for management control is by their underlying behavioural assumptions, specifically in terms of how opportunism is conceptualised: coordination problems do not assume opportunism; appropriation problems arise as a result a particular type of opportunism (relating to external spillovers or misappropriation of resources); and cooperation problems are based on the assumption of a broad range of opportunistic behaviours, such as hold-up, misrepresentation and shirking. This differentiation of cooperation, coordination and appropriation control problems could be used to extend upon the previous contributions (e.g. Dekker 2004; Gulati & Singh 1998), that examine the co-existence of multiple control problems within the same organisational setting. This line of inquiry would seem promising given Williamson (1991) himself suggests that the need for alternative governance modes derives not only from their ability to safeguard against different forms of opportunism, but also from their varying

‘adaptive capacity’ to enable cost-efficient coordination. Future studies could revisit this line of inquiry, and decompose coordination and appropriation control problems to examine co-existence and possible interrelation of different inter-organisational control problems at ex ante, point of contract, and ex post phases inter-organisational exchanges. Alternatively, studies could more closely examine the how varying control problems influence the design and use of single control mechanisms, examining the degree to which differing control imperatives are accommodated simultaneously within MCS design.

The implications of these results for practice relates to how managers may be able to understand the underlying causes of some problems in external R&D contracting. Organising R&D in an inter-organisational context introduces a divergence of interests between specialised and autonomous parties, who may have different motives and priorities for participating as either funders or providers of an R&D exchange. Without intervention, these divergent interests, when combined with the specificity, inherent uncertainty, and information gaps in R&D projects, may cause tension, problems or conflict when attempting to negotiate mutually agreeable project contracts; to make optimal project investment decisions; and to ensure compliance with agreed contractual specifications.

In relation to R&D more specifically, the problematisation of cooperation issues using a TCE framework highlights the role of asset specificity in causing managerial problems in science-based exchanges. This is not only because asset specificity causes bi-lateral dependencies at ex ante and ex post stages of an exchange (Dekker 2004; Gietzmann 1996; Gietzmann & Larsen 1998); but also because of a conflict that between commercial R&D funders, who prefer highly-specific, applied R&D projects, yet who also want to maintain a flexibility to change to alternative technological options as they arise; and providers in public researcher agencies, to whom short-term highly specific projects may have a lower ‘science’ value than more long-term or less-context specific work. This indicates that managers acting on behalf of funders should consider the long-term implications of asking researchers to make funder-specific investments. Managers should attempt to achieve a match between the contracting terms they offer and the relative pay-off period for the costs of specialisation borne by researchers. This may involve extending project lengths,

committing to longer concurrent funding commitments, or alternatively accepting less funder-specific project proposals.

11.2.2. *Hybrid and embedded MCS control solutions*

The second contribution of this thesis is to provide a clearer understanding of the nature and relation between the control solutions of hybrid governance structures and MCS in inter-organisational R&D exchanges. This encompassed two interrelated aims: to provide a more comprehensive account of the types of control solutions found within inter-organisational arrangements; and to examine how hybrid governance structure and MCS relate as control solutions.

To conceptualise the nature of potential control solutions, in Chapter 3 I referred to existing inter-organisational control research to identify two inter-related choices: the choice of hybrid governance structure and the choice of embedded MCS. The alternatives within these two choices were then developed by integrating inter-organisational management control research with insights from broader economic literature about hybrid governance and empirical studies of inter-organisational R&D arrangements. The resulting framework described control solutions as a combination of the type of hybrid, which vary in terms of three structural dimensions (formalisation, centralisation and relational governance), and embedded MCS (including planning mechanisms, monitoring and reporting systems, incentives and social mechanisms).

In addition, to conceptualise the interdependencies between hybrid structures and MCS control solutions, in Chapter 4, I reviewed inter-organisational management control studies that consider the control capacity of both hybrid governance structures and MCS. I found two alternative ways prior research has conceptualised how hybrid governance choices may influence MCS choices: the first, which I labelled the ‘archetypal approach’, implies that MCS and hybrid structures form into distinct configurations; and the second, the ‘misalignment approach’, implies that MCS are used to compensate for misalignment in choice of governance mode.

I applied my initial conceptual framing of control solution choices to my two case descriptions in Chapters 8 and 9 to characterise and differentiate the management control

capacity of the two arrangements. My empirical results showed that despite similarity in their operating contexts, the two arrangements comprised of different and distinct combinations of control solutions to address each of the cooperation control problems, characterised by varying structural dimensions, structure-wide MCS and project-level MCS. These results extend previous research into inter-organisational R&D by providing further differentiation between alternative models of inter-firm R&D management, in this case between 'market-like' flexible subcontracting arrangements (Gietzmann 1996; Gietzmann & Larsen 1998; Mouritsen, Hansen & Hansen 2001; Revellino & Mouritsen 2009) and 'hierarchy-like' equity-based-alliances (Dekker 2004; Oxley 1997; Pisano 1989; Sampson 2004). In addition, the results provide further detail about the underlying MCS mechanisms which enable these two different forms to operate.

Also, in Chapters 8 and 9 I examined patterns of relations between structural characteristics and the design and operation of MCS in each inter-organisational arrangement. I found that each case appeared to represent an internally congruent combination of control solutions, and further, that there were consistent cross-case patterns in the variation of each structural dimension and differences in MCS. The second set of patterns I examined was in the use of control solutions in relation to the three cooperation control problems. This analysis showed that each hybrid arrangement has relative strengths and weaknesses in handling different types of control problems and different types of transactions. These weaknesses appeared to correspond to patterns in the relative intensity of project-level MCS use across contractual phases and idiosyncratic MCS responses.

These findings provided a series of interrelated insights relevant for the on-going conceptual development of inter-organisational management control work, which I discussed in Chapter 10. The analysis showed how structural dimensions combine to give different hybrid governance structures a distinct control capacity in their own right. In other words, each inter-organisational arrangement is not merely the context in which management control occurs; its own structural characteristics mitigate and manage cooperation control problems.

Also, these empirical results provide support to *both* the archetypal and misalignment approaches to conceptualising interdependencies between hybrid structures and MCS. I reconcile these findings by proposing that different MCS relate to the hybrid structures in different ways: some MCS – particularly more structure-wide MCS – are used to support or *complement* hybrid functioning; whereas more project or transaction-specific MCS are used to *compensate* for misalignment. Furthermore, I differentiated between a more standard compensatory use of MCS, which occurs when MCS are used for all exchanges administered within the hybrid; and idiosyncratic compensatory use of MCS, where MCS are used for particular instances of transactional misalignment.

Implications for future research and for practice

The study's results reveal the potential to enrich our understanding of inter-organisational management control by recognising the control capacity and variation of hybrid forms. Rather than treating inter-firm arrangements as homogenous contexts for new forms of management control, accounting researchers can leverage off the broader economic literature on hybrid arrangements to develop more sophisticated and complete understandings of the control capacity of these different structures. Within this study I have examined two types of hybrid arrangement; there remain many other forms, such as franchising, supplier parks, cartels, licensing agreements, cooperatives, supply chain networks, and reciprocal trading agreements, whose MCS implications remain to be explored. Within the inter-organisational R&D domain more specifically, these results provide detail about the MCS used within two relatively well-established hybrid types – equity alliances and subcontracting (Gulati & Singh 1998; Oxley 1997; Pisano 1989; Sampson 2004). Future studies could explore the MCS implications of more emergent inter-firm forms, such as those described in the growing literature on open innovation (Chesbrough 2003a, 2003b; Ding, Dekker & Groot 2010; Hagedoorn 2002; Powell & Grodal 2005).

The conceptual categorisation of hybrid structural characteristics developed in this thesis may also provide a more systematic basis for accounting researchers to study the management control implications of different hybrid forms. Future researchers could use

dimensions such as formalisation and centralisation to inform the selection of contrasting cases, or alternatively as a way of relating their observations to others' empirical work.

The results from this study also reinforce the view that control choices are interdependent within a more extended make-or-buy decision (Anderson & Dekker 2010; Johansson & Siverbo 2011; Van der Meer-Kooistra & Vosselman 2000). In order to fully comprehend the interdependency of control choices, future inter-organisational studies should avoid examining MCS in isolation and instead adopt a more 'combinative view' (Caglio & Ditillo 2008) by considering how hybrid governance structures and MCS operate simultaneously. For example, future research could extend this study's findings by examining the patterns of MCS within more extreme cross-sectional variation in hybrid structures to verify the associations between structural characteristics and certain types of MCS. Researchers could also use more robust research designs (e.g. using multi-level research designs) to explore the emergent insights regarding standard vs. idiosyncratic compensatory use of MCS.

In terms of practical implications, these results reveal that managers can overcome contractual difficulties in inter-organisational R&D through choosing to administer exchanges through hybrid structures. While lacking the hierarchical control of vertical integration, hybrids appear to offer significant advantages compared to arm's length contracting, including an ability to create a sense of continuity in contracting, to contractually and socially bond parties to common interests, and to institute some forms of managerial authority.

Also, while there appear to be some general advantages of hybrid forms, managers should recognise that different hybrids have relative strengths and weaknesses. That is, a hybrid's control capacity can be adjusted through variation in structural features such as centralisation of decision and property rights, centralisation of monitoring and control rights, formalisation, and relational governance. In this sense, the findings of this study echo others who have claimed that the choice of organisational structure matters within inter-organisational arrangements:

The structure of collaboration – or alliance governance – is often over-looked by managers when negotiating collaborative R&D. Collaborative ventures are frequently the brainchild

of senior executives who, after negotiating what capabilities each firm brings to the alliance, leave further details unaddressed. I argue that leaving alliance governance to chance or otherwise failing to align governance limits collaborative benefits. (Sampson 2004 , p.485)

To this I would also add that the choice of MCS within that structure also affects the degree of collaborative benefits. This is because MCS can be tailored to support the unique functioning of different forms of hybrid structures, and also can be used to compensate for weaknesses or problems that are exacerbated by the design of the arrangement. This may be a particularly salient point for managers working within structures whose design is pre-determined by broader institutional or regulatory forces.

11.2.3. The relation between control problems and solutions

The third contribution of this thesis concerns the relation between control problems and solutions, which I have explicated in a preliminary model. This model emerged inductively during the latter stages of data analysis and interpretation in an effort to depict a relation that was consistent with the patterns of interdependent control choices I had observed.

The construction of this model is detailed in Chapter 10, where I replaced the notion of an exogenous control problem with a ‘control problem potential’, and used the extended make-or-buy decision (Johansson & Siverbo 2011; Van der Meer-Kooistra & Vosselman 2000) to structure a series of interdependent control choices (hybrid type, structural characteristics and embedded MCS). Whereas earlier formulations of the extended make-or-buy decision imply that all control choices are influenced by a single control problem, I propose that each control choice is determined by residual control problem potential – a construct that describes the adequacy of existing control solutions.

My model therefore depicts an interactive dynamic between control problems and solutions that starts with a generic, latent potential for control problems; followed by initial safeguarding by the hybrid design, creating a residual control problem potential; followed by further safeguarding by MCS, which further refines the residual control problem potential, and so on, until all that remains is a residual control loss. This can extend management control research by providing more nuanced constructs and depth of

explanation to the logic of control problems and control solutions; this is an emerging style of theorising MCS design and use, which is gaining traction with accounting literature. Also, the application of this model to inter-organisational R&D shifts the emphasis on *what type* of control solutions are used in particular contexts (Anderson & Dekker 2010).

In Chapter 10, I also explored the question when we would *not* expect the relation between control problems and solutions to hold, by exploring the reasons why managers may not exercise their capacity to alter control solution combinations to achieve perfect alignment to control problems, and instead accept a residual control loss greater than zero. Based on my empirical observations, it appears that reducing residual loss to zero and achieving perfect alignment may be difficult, particularly in arrangements involving multiple trading parties and administering several exchanges. In this context, I propose that there are at least three constraints to efficient alignment: the relative cost efficiency of adaptation, the need for internal consistency in control solutions, and the need for equity between different parties. These constraints may explain why management control in multi-party, multi-transaction arrangements is more complex (Anderson & Dekker 2010), as managers have to trade-off the benefits of achieving alignment for an individual or subset of transactions versus the costs or negative impacts that are borne at a portfolio or aggregate level.

Implications for future research and for practice

This preliminary model provides an attempt to map the relation between control problems and solutions. Further research is required to explore the degree to which this model consistently explains managerial responses to control problems in other settings, especially given the inherently high level of abstraction of these two constructs.

The model may also provide the basis for more informed methodological choices in MCS work, specifically considering the linkages between conceptual explanations of control problems and solutions, and what may be empirically observed. The constructs and logic of control problems and control solutions are compelling in that they provide an explanation for MCS design and use formulated in terms of managerial imperatives. These explanations potentially have more correspondence to qualitative accounts from managers in practice, relative, for instance, to contingency based explanations that require higher degrees of

abstraction to test empirically. Nonetheless, one of the challenges in applying this system of logic is being able to diagnose the current state of control problems, and their relation with control solutions, from managerial accounts. Managers' own accounts may not always provide reliable reflections of the relative optimality of a current control mechanism in place, as they could also be influenced by a lack of awareness of the potential for control problems or incomplete understandings of the current control solutions and their capacities. Further work is required, for instance using interpretative methodologies, to develop systematic approaches to diagnosing control problem/solution interactions in practice.

In addition, although the conceptual model I propose assumes an unlimited managerial capacity to alter control solution combinations to achieve perfect alignment to control problems, I recognise that in practice, there may be other concerns – cost efficiency, internal consistency and equity – that constrain this. All three of these concerns relate to a trade-off between the benefits of modifying control solutions to achieve alignment for an individual or sample of transactions, versus the costs that are borne at a portfolio or aggregate level. As these pressures seem more likely to occur in arrangements involving multiple exchanges with alternative trading parties, future research could investigate the effects of transactional heterogeneity and examine the management control efforts used to manage different specific transactions within the same hybrid arrangement.

My model has two implications for managers in practice. The first concerns the difficulty in diagnosing the current state between potential control problems and existing solutions. While 'unsolved' control problems may be salient and easy to diagnose, it may be more difficult to establish whether the apparent absence of a control problem represents a relatively benign unproblematic situation or alternatively a situation where there is a severe, but latent control problem potential that is being held in check by existing control solutions. In such cases, managers may erroneously seek to remove or adjust effective and efficient control solutions.

The second implication concerns the constraints to efficient alignment when managing portfolios of transactions. The discussion in Chapter 10 suggests there may be several reasons why managers should tolerate situations of apparent misalignment and not adjust

management strategies used for the entire portfolio for the sake of individual or a small sub-set of transactions. For example, adjusting management strategies may not be cost-efficient, particularly if such modifications require a significant adjustment to existing governance structures and MCS. Second, modifications may create internal consistency problems or ‘mixed signals’, particularly if they introduce combinations of relational and formalised forms of contracting. Third, modifications could erode a sense of equity, particularly if they create an appearance of preferential treatment.

11.3. Study limitations

The multiple case study approach was used to take advantage of the opportunity to conduct an in-depth comparative study of the control structures and mechanisms used within two alternative hybrid arrangements within the same industry context. The similarity of the operating context of these two cases provided the basis to study variation in the nature and relations between control problems and solutions; however, there are some limitations in using this approach, which should be acknowledged when interpreting the study’s findings.

The first set of limitations relates to issues in the general research method. As with all case study research, these findings have been developed in reference to specific cases, and thus may be influenced by context-specific factors that limit their generalisability to other settings. The correspondence between the current findings and other studies’ observations gives confidence that the results have ‘analytical generalizability’ (Eisenhardt 1989; Yin 2003); nonetheless, care should be taken when applying these findings to explain management control in other inter-organisational R&D settings. For example, one of the rationales for choosing these cases was that they occurred within an industry with a long history of inter-organisational R&D arrangements; researchers may likely observe alternative patterns of management control in settings where inter-organisational arrangements have only recently been adopted as an organisational practice.

In addition, although I have approached the study of the two cases in a manner similar to a natural experiment (Yin 2003), cross-case results relating to variation in phenomena should be interpreted with care. As I described in Chapter 5, the benefit of using a qualitative approach is the ability to directly access manager’s own rationales for using certain control

structures and systems, which were used to confirm the patterns identified as consistent with expectations both within and across the cases (Eisenhardt 1989). However, these cross-case patterns do not equate to statistically verified associations; without study across a larger number of cases it is difficult to establish to what degree variation in control system design reflects intentional efficient responses to control problems or simply more benign, natural variation in practice. Furthermore, there may also be contextual factors taken-for-granted that shape the use of control structures and solutions, which were not remarked upon by the study's interviewees and remained undetected in my analysis.

The second set of limitations relates to the nature of my empirical data. I have not been able to examine the choice of governance structure directly, as in both cases the decision to enter into a hybrid arrangement pre-dated the study. Furthermore, in both cases, the actual choice of hybrid type was pre-determined by the legislation governing their establishment and funding. As a consequence, I have not been able to observe the interaction between the choice of governance structure and the choice of MCS directly; rather I have inferred this relation from how pre-existing structures and mechanisms have been rationalised by managers and used. Therefore, it remains for future research to examine the relation between hybrid structure choice and management control system configurations in situations where the participants have more agency and discretion, and where researchers can observe these choices being made over time.

Also, the information about the nature of R&D transactions has been presented and analysed as average transaction qualities. While efforts have been made to use illustrative examples within the case material to show general transaction characteristics, as well as how transactions vary within the portfolio, I was unable to analyse all material at the individual transaction level. This case work therefore lays the groundwork for more detailed quantitative study using data-sets containing information about the management of individual transactions.

11.4. Concluding remarks

There seem to be several salient advantages in organising R&D through external contracts, rather than relying on in-house production. It enables organisations to access a substantially

wider range of competencies than could be maintained in-house, allowing the simultaneous pursuit of a diverse range of technological options; this potentially accelerates the pace of development and reduces the risk of committing to any one direction. External technology development also demands that parties explicitly contract around discrete project activities, creating a richer information environment to organise within, and forcing greater specification and clarification of priorities and planned activities and outcomes. Furthermore, while traditional models of innovation systems rely on intermediaries to translate, communicate, and disseminate R&D outcomes from dedicated research providers to end users, external R&D exchanges establish much more direct connections and communication channels between the users and creators of R&D, allowing for quicker dissemination, as well as improved understanding of user needs and priorities. Finally the collective investment in R&D alleviates the risk of market failure, by ensuring that the cost of R&D investment is shared by many of the contributing organisations who will benefit from its outcomes.

In light of these comparative advantages, it seems likely that current trends towards an externalisation of the R&D function will persist. However, this study joins a growing body of literature that documents the managerial challenges that organisations are confronted with when organising their technology activities beyond their entity's boundaries. In addition to the need to coordinate the integration of contributions across a more decentralised production based, and to protect against the risk of knowledge spill-over and appropriation, organisations are also confronted with the challenge of anticipating and responding to the risks that the autonomous, specialised trading counterparts, upon whom they depend, may act opportunistically in different ways at different phases of an R&D exchange. While these challenges are not insurmountable, it appears that they require intentional considered managerial responses. Taking into account the various opportunities for self-interested behaviour that may occur at differing contracting phases, managers can address cooperation issues by engaging in a series of choices regarding how the arrangement is structured, how they then design and use management control mechanisms, and how these elements interact to provide a holistic system of control solutions.

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Appendix

Appendix A Inter-organisational management control research

Table 17: Inter-organisational management control research

Source	Domain	Focal control solutions	Governance structure(s)	Embedded management control systems	Empirical material
Gietzmann 1996	Japanese subcontracting of subcomponent design and production activities	Formal contractual mechanisms; relational contracts	Relational contracting with subcontractors	Long-term contracts; rank order tournaments and rewards; delayed claw-back procedures; information exchange; non-contractual resolution mechanisms; personal interaction; trust, reputation	Survey of 18 European first-tier subcontractors of a Japanese assembler
Birnberg 1998	Strategic alliances (not specific)	Contractual mechanisms	Strategic alliances	Market-based contracting; contracts with credible commitments; flexible, long-term contracts	None
Widener & Selto 1999	Outsourcing of internal audit function	Governance structure (make-or buy)	Hierarchy or market	Not studied	Survey of 83 large US firms
Roodhooft & Warlop 1999	Outsourcing decisions of hospital administrators	Governance structure (make-or buy)	Hierarchy or market	Not studied	Experiment with 156 hospital managers
Van der Meer-Kooistra & Vosselman 2000	Inter-organisational relationships (not specific)	Patterns of control (market-based, bureaucracy-based, and trust-based control)	Inter-organisational relationships (hybrids)	Selection and tendering processes and criteria; design of the outsourcing contract; organisational structure; performance evaluation and monitoring processes; methods of payment/penalties	Case study of two long-term outsourcing arrangements (industrial service and maintenance)
Anderson, Glenn & Sedatole 2000	Outsourcing of subcomponent development and design by US auto assemblers	Governance structure (make-or buy)	Hierarchy or relational contracts	Not studied	156 sourcing decisions for development and manufacture of process tool

Source	Domain	Focal control solutions	Governance structure(s)	Embedded management control systems	Empirical material systems
Speklé 2001	All organisational modes (not specific)	Archetypes of control	Hierarchy, market and hybrid	Arm's length control; boundary control; exploratory control; machine (results or action) control	None
Vosselman 2002	Management of centralised support services	Management control archetypes	Hierarchy, market and hybrid	Market, bureaucratic mechanisms; vertical management control mechanisms; information flows	Based on case study of Leiden University
van den Bogaard & Speklé 2003	Strategic restructuring (divestment)	Control structures	Hierarchy, hybrid (long-term contractual relations)	Emergent contracts; planning; budgeting; procedures; committee-based dispute-resolution mechanisms; incentives	Case study of Shell 'carve out'
Langfield-Smith & Smith 2003	Outsourcing through long-term strategic alliance structure	Patterns of control (market-based, bureaucracy-based, and trust-based control)	Strategic alliance	Partner selection processes; emergent contract as framework; development of performance assessment; level of information sharing; goodwill and competence based trust	Single case study of formation of strategic alliance in IT/Telco
Dekker 2004	Development of joint innovation in long-term strategic alliance structure	Outcome control; behavioural control; social control (goodwill trust, capability trust, partner selection)	Strategic alliance	Contract; organisational structure; planning, budget; financial incentive system; IP protection; trust and trust building mechanisms	Case study of strategic alliance (development of railway safety equipment)
Cooper & Slagmulder 2004	Outsourcing in different relational contexts	Inter-organisational cost management (IOCM) practices during product design	Hybrid (relational contracts with family member or major supplier); market (arm's length subcontracting)	Functionality–price–quality (FPQ) trade-offs; inter-organisational cost investigations; concurrent cost management	Three buyer-supplier chains between Japanese manufacturing organisations
Sartorius & Kirsten 2005	Outsourcing decisions in sugarcane production in Africa	Governance archetype	Spot market, specification contract, strategic alliance, formal cooperation; vertical integration	Ex ante control; ex post importance; information shared; contract enforcement	Case study of two South African sugar cane companies

Source	Domain	Focal control solutions	Governance structure(s)	Embedded management control systems	Empirical material
Anderson & Dekker 2005	Outsourcing of IT project transactions	Contract extensiveness and structure	Outsourcing	The total number of contractual terms; terms related to rights assignment; after sales service; product and price; legal recourse terms	Survey of 858 outsourced IT transactions
Nicholson, Jones & Espenlaub 2006	Outsourcing of offshore accounting and finance function	Ex post control practices	Wholly owned foreign subsidiaries; vendors serving former parents; third party procurement	Boundary controls; machine and exploratory controls; arm's length control	Case studies of Indian suppliers to UK firms
Donada & Nogatchewsky 2006	Asymmetric buyer/supplier relationships	Patterns of control (market-based, bureaucracy-based, and trust-based control)	Outsourcing relationships	Bidding and selection practices; contract detail; arbitration; hostage arrangements; monitoring; rewarding; information and surveillance systems; rules; goodwill and competence based trust; relational rules	Three case studies
Kamminga & Van der Meer-Kooistra 2007	Joint ventures	Patterns of control (content-based; consultation-based control; context-based control)	Joint ventures	Personnel, financial mechanisms; the exchange of formal information; meetings and personal contacts	Two joint venture case studies
Speklé, van Elten & Kruis 2007	Outsourcing of internal audit function	Governance structure (hierarchy or market)	Make-or-buy decision	Not studied	Survey of 66 firms in the Netherlands
Langfield-Smith 2008	Strategic alliance	Development of control practices	Non-equity based strategic alliance	Behavioural control, output control and social control; partner selection and processes that develop trust	Case study of a strategic alliance formation in the construction industry
Dekker 2008	Outsourcing of IT project transactions	Contract extensiveness; partner selection; prior ties	Outsourcing	Contract extensiveness; partner selection effort; social control (prior partner experience)	Survey of 817 outsourced IT transactions

Source	Domain	Focal control solutions	Governance structure(s)	Embedded management control systems	Empirical material
Neumann 2010	Strategic alliance in airline industry	Ex ante formal governance mechanisms; partner selection; trust	Strategic alliance	Partner selection; allocation and decision rights; IP; hostage arrangements; performance and behaviour monitoring and rewards; information sharing; open book accounting; benchmarks	Single case study of a strategic alliance between two airlines
Balakrishnan et al. 2010	Outsourcing of hospital activities	Governance structure (make-or buy)	Hierarchy or market	Not studied	Survey of clinical and non-clinical services for 459 Hospital-years
Phua, Abernethy & Lillis 2011	Ease of switching supplier in outsourcing relationships	Market-based control; bureaucracy-based control; trust-based control	Outsourcing	Competitive bidding, standard contracts; surveillance, monitoring evaluation, rules, standards; reliance on trust (goodwill and competence), trust-building activities	53 specific outsourcing decisions by 29 Australian firms
Johansson & Siverbo 2011	Outsourcing in public service organisations	Market-based control; Bureaucracy-based control; trust-based control; ex ante and ex post	Outsourcing	Bidding and selection practices; output, action and social controls; performance measurement monitoring; degree of interaction and information flow	Survey of 71 local government organisations in Sweden