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Impact of Knowledge Management and Inter-Organizational System on Supply Chain performance: The Case of Australian Agri-Food Industry

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Declaration

To the best of my knowledge and belief, this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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Mohammad Nasir Uddin

5 November 2010

Dedication

This dissertation is dedicated to Dr. Johurul Islam and Dr. Nasim Iqbal. My thanks to both of these wonderful persons for opening the door to a fascinating personal and professional journey.

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The road to a doctorate degree is a long and challenging one and there is no doubt in my mind that I would not have been able to walk through it alone. Although the individuals that helped me reach my goal are too many to count, there are a number of them, whom I will always be grateful.

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The success of an empirical study depends on the interest of the business community. In this respect I would like to thank the industry stakeholders, specially AgForce Queensland, and the producers, processors and retailers’ firms in Western Australia and Queensland who spent their valuable time to be interviewed or surveyed. This research would not have been possible without their active participation.

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List of Abbreviations

DAFWA	= Department of Agriculture and Food, Western Australia
EDI	= Electronic Data Interchange
IOS	= Inter-Organizational Systems
KAM	= Knowledge Asset Management
KBV	= Knowledge-Based View
MAR	= Missing at Random
MCAR	= Missing completely at random (MCAR
MLE	= Maximum Likelihood Estimation
MNAR	= Missing Not at Random
MVA	= Missing Value Analysis
PLS	= Partial Least Square
QLD	= Queensland
RBV	= Resource-Based View
SC	= Supply Chain
SCM	= Supply Chain Management
TCE	= Transaction Cost Economics
WA	= Western Australia

Abstract

Motivated by the problems of cost competitiveness, profitability and market development issues in the Australian agri-food industry, this study was designed to addresses research questions as to how levels of knowledge asset management, inter-organizational systems (IOS) and relationship structures impact on the performance of a supply chain and differentiate the performance of the industry. Supply chains in the Australian agri-food industry have been based mainly on market arrangements with operation production pushed and, often, adversarial, resulting in profitability problems and a lack of innovative actions in developing products and a business based on insights from customers.

With the main objective of investigating sources of supply chain performance in the Australian agri-food industry, five specific objectives were investigated. The preliminary conceptual model were developed principally using supply chain management and marketing literature in agribusiness and concepts from resource-based view (RBV), knowledge-based view (KBV) and transaction cost economics (TCE). The study objectives were addressed by a mixed method research methodology through a pragmatist approach that involved a first phase of qualitative data collection to enhance the theoretical model and develop survey instruments, followed by a second phase of quantitative data collection and analysis to test the research hypotheses.

The qualitative first phase was based on in-depth interviews with eight agri-food firms to explore the research questions in real-world conditions. Content analysis of the interview transcripts helped identifying important factors and variables related to the performance of the supply chain which, later, were aligned with the literature and enhanced the initial theoretical research model and hypothesized relationships. The second phase involved finalizing the research model that used 22 hypotheses targeting factors of supply chain performance in the specific agri-food industry; viz., the Australian beef industry. A questionnaire was developed and pretested, followed by a pilot study of 68 participants. Finally, data were collected through a random telephone survey of 315 firms including input suppliers, producers, processors and retailers in the beef industries of Western Australia and Queensland. The data were analyzed using partial least square (PLS) based structural equation modelling (SEM).

Assessment of the research model demonstrated that 18 of the 22 hypotheses, made up of 11 primary factors and 15 sub-factors, were supported. Results indicated that, among the predictive factors, *knowledge asset management* was the strongest predictor of supply chain performance, followed by negotiation power, price uncertainty, inter-firm relationship strength and environmental management practices. Competition intensity, vertical coordination and transaction climate were significant antecedents of knowledge asset management, IOS use and inter-firm relationship strength in the Australian context. Results established that relationship strength in the supply chain depends on the level of commitment, mutual investments, trust and interdependence of the firms. The non-significant relationship between IOS and supply chain performance indicated that IOS, by itself, cannot produce sustained performance advantages unless pre-existing complementary human and business resources are exploited in an integrated way. Finally, statistical evidence proved that the supply chain is a source of competitiveness in the industry and that competitive advantage lies in system efficiencies in the performance of the supply chain.

Finally, the study provides frameworks for developing the strategies of inter-firm relationships, knowledge asset management and the use of electronic systems in the supply chain to align the best principles of value-creating strategy in firms and in the industry, for competitive advantage. Thus, the results have provided a comprehensive, reliable and valid model of supply chain performance that contributes to knowledge at the strategic level for appropriate planning and benchmarking to improve performance of the agri-food industry. Finally, although the hypothesized relationships in the model have been tested in the beef industry in Australia, the issues can be examined not only in other sectors of the Australian agri-food industry supply chain but also in other agricultural sectors within Australia and overseas.

Chapter 1

Introduction

1.1 Research Background

The concept of Supply Chain Management first emerged in the manufacturing industry to manage intra- and inter-enterprise business processes efficiently (Coyle, Bardi and Langle 2003). The agricultural industry, however, is different in terms of corporate environment, product characteristics and the importance of downstream information flows. In particular, the agri-food industry supply chain is quite challenging as it involves high risk and uncertainty emanating from weather and seasonal variations, as well as from well-informed consumers with their requirement for product quality, variety and freshness. The factors that ultimately affect how the agri-food industry will be organized are the development of inter-firm relationship structures, and the integration of the knowledge flows in the supply chain. Therefore, the agri-food supply chain management is characterized by inter-organizational coordination or relationship management where success hinges on how each company in a supply chain coordinates and combines its business partners and integrates its information flows to gain a competitive advantage and to optimize its business performance (Clare *et al.* 2002).

Traditionally, Australia is an exporter of wheat, meat, wool and other agricultural products, and the food industry is also a major component of the Australian Economy generating export income of around $24 billion a year (DAFF 2008). The meat industry is the largest industry with a total supply value of around $15 billion. Major inputs into food manufacturing are comprised of 32 percent raw agricultural products, 26 percent major services, 17 percent labor and 13 percent of food products (Short *et al.* 2006). Supermarkets and grocery outlets represent the majority of food sales in Australia, accounting for around 62 per cent of the value of total food and liquor retail. About 75 per cent of the food industry's revenue was generated by fifty firms, more than half of which were foreign-owned or publicly-listed companies (Short *et al.* 2006). To expand the volume of sales, major supermarket chains such as

Woolworths, Coles, and IGA are investing in strategies to reduce supply chain costs in order to lower retail prices and improve margins.

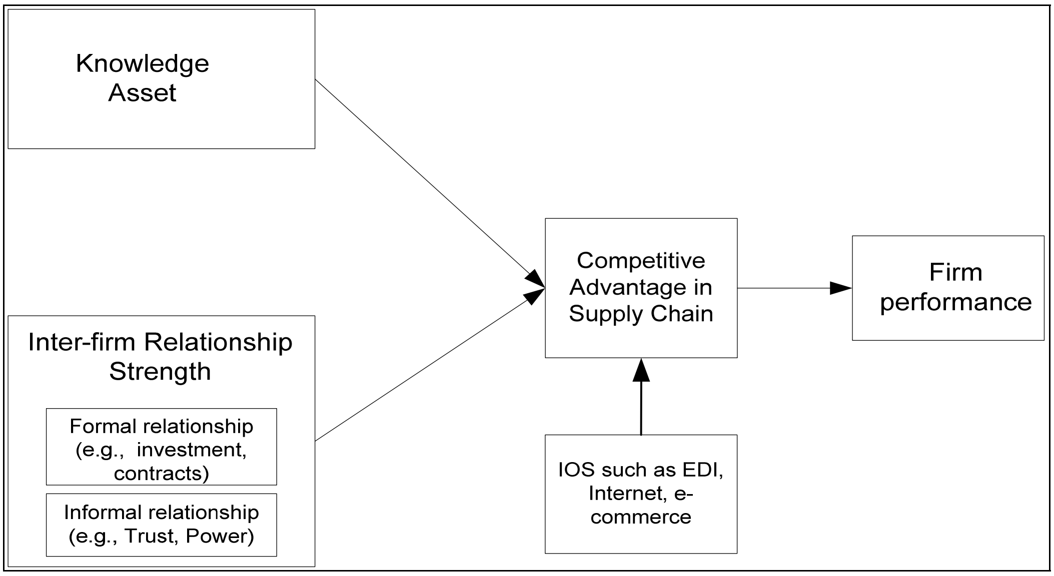
However, the reality is that the farm-products share of Australia’s GDP has been declining over the last century as compared to the proportionate growth of other sectors in the Australian economy. While in the first half of the 20th century the value was about a quarter of Australia's GDP with 70 to 80 per cent being exported, today this has fallen to approximately 3.3 percent of GDP with exports of around only 20 percent (DAFF 2008). The major factors affecting the food and agricultural processing industry have been identified as export competitiveness and market development issues (INSTATE 2000; MLA 2008) such as less committed entrepreneurship in export-oriented food industries, operational inadequacies and the lack of innovativeness of smaller and local firms, a failure to achieve cost competitiveness and competitive advantage in business performance, low levels of labor productivity, and less effective government support (Islam and Johnson 2003). Besides, recent studies found a low trust buyer-supplier environment, dominance of spot market, and isolation of the growers from the mainstream food chain are causing a comparative decline in the performance in Australian agri-food companies (Uddin and Quaddus 2008; WY and Associates 2009).

Drawing on the above concerns of declining performance in the Australian food industries, this study combines the insights of organizational theories, supply chain management and institutional economics in improving innovation, dynamism and competitiveness of the agri-food industries in Australia. Theoretical and empirical studies emphasize that a firm can gain competitive advantage and better performance by improving their knowledge asset and transactional relationships in the supply chain following the principles of resource-based (RBV), knowledge-based view (KBV), and the transaction cost economics (TCE) (Hobbs 1996, 2000; Hult *et al*. 2004, 2006; Ketchen and Hult, 2007; VanderVorst and Beulens 2002; Reve and Stern 1976; Szabo and Bardos 2005). In relation to RBV and KBV (Barney 1991; Grant 1996), it has been suggested that the relative ability to build and utilize strategic internal resources/knowledge and capabilities in the business process lead to a firm’s competitive advantage and, eventually, improved performance. Transaction Cost theory (Williamson 1975, 1985), on the other hand, suggests a closer buyer-seller relationship for minimizing inter-firm transaction costs and gaining competitive advantage for a better firm performance.

The diverse literature in agri-food supply chains can be divided into three streams (Bijman *et al.* 2006; Trienekens *et al.* 2003*)*. One stream focuses on the supply chain management (SCM) to optimize supply chain processes within and between the firms and studies the whole chain, not just dyadic parts of it (e.g., Grover and Malhotra, 2003; Lu *et al*., 2006; Newton 2000; O'Keeffe 1998). The second stream mostly focuses on transaction cost theory and the method of vertical coordination to analyze and design the most efficient structure of supply chain transactions (e.g., Menard and Valceschini 2005; Hobbs 1996, 2000; Escobal *et al.* 2000). The third stream is the network approach that focuses on multidimensional relationships between firms and includes those who are not part of the supply chain such as accountancy, advisory services, equipment providers (e.g., Powell 1990; Uzzi 1997). Supply Chain studies also focus on performance factors as they are important to assess the effectiveness and efficiency of the chain (Beamon 1999; Gunasekaran 2004). There are many performance indicators such as product availability, reliability, delivery time and so on. A method to measure these multiple indicators, specially designed for a chain, is the Supply-Chain Operations Reference – SCOR (Supply-Chain Council, 2004).

This study takes a differential approach and addresses the gap in the literature in the areas of knowledge management and inter-firm relationship issues, particularly in the context of Australian agri-food industries. Very few studies (e.g., O'Keeffe 1998; Newton 2000; Storer 2000) have focused on the Australian food supply chain and are limited to general SCM and relationship development issues. The current approach, in contrast, is quite different as it combines the cumulative influence of organizational theories and new institutional economics to develop a model (see Chapter 2). It uses RBV, KBV and TCE as theoretical lenses where three main factors, namely, 'Knowledge Asset Management', 'Inter-organizational System Use', and 'Inter-firm Relationship Strength' are investigated in relation to their influence in supply chain performance and competitiveness within the Australian agri-food industry. The initial idea of this study is presented in Figure 1.1

Figure 1.1 Supply Chain Competitive Advantage and Firm Performance



Most prior studies focused on the use of inter-organizational system (e.g., EDI) or structural factors of the buyer-seller relationship to determine the performance of a supply chain (e.g., Grover 2007; Premkumar 2000; Kim *et al.* 2005). The proposed study will follow a unique approach to explore the tripartite effect of knowledge management, inter-organizational systems, and structural/economic as well as behavioral climate of the buyer-seller transaction relationship in the supply chain. In addition, this study will explore the external factors of technological policy, competitors and environmental management practices which are believed to have an environmental influence on the Australian agri-business sector and, therefore, will be investigated to evaluate their impact in strengthening inter-firm relationship, managing knowledge assets and supply chain performance. The following sections detail the research questions, objectives and significance of this study.

1.2. Research Questions

Based on the aforesaid role of the supply chain in improving performance of the agri-food industry, it is believed that the supply chain can be a strategic weapon for competitive advantage when used with improved information and the knowledge chain, and an improved collaboration and relationship structure among the members of the industry (Cohen and Roussel 2005; Lee 2000; MLA 2008). Therefore, the motivation of this study is to explore empirically and test the relationship between knowledge management, inter-organizational relationships and supply chain performance in the context of the Australian agri-food industry. Thus, this study attempts to answer the following primary research questions:

RQ1: How do the supply chain members of the agri-food industries maintain transactional relationships and how do these influence supply chain performance?

RQ2: What are the current practices of knowledge asset management (KAM) and inter-organization system (IOS) in the supply chain of Australian agri-food industries and how do these influence supply chain performance?

RQ3: How do the levels of KAM, IOS use and transactional relationships impact on the supply chain and differentiate the performance of the Australian agri-food industry?

These questions will be addressed sequentially using a mixed method research approach. Question 1 and 2 principally will be addressed in a qualitative field study based on in-depth interviews, which will also provide the context for Question 3 and related hypotheses. Survey data and structural equation modeling (SEM) will be used to test the hypotheses, draw conclusions and discuss the implications for the Australian agri-food industry.

1.3 Objectives

Based on the above, the specific objectives in the research are:

RO1. To explore the existing formal and informal transactional relationships in the agri-food industry and their effect on supply chain performance.

RO2. To investigate and characterize the current knowledge asset management (KAM) and inter-organizational system (IOS) use in the supply chain of Australian agri-food industry.

RO3. To explore the antecedents of KAM, IOS and transaction relationships in the supply chain of the Australian agri-food industry.

RO4. To examine which elements of KAM and transactional relationships significantly impact and influence supply chain performance improvement.

RO5. To identify how and to what extent KAM, IOS and transactional relationships create competitiveness and performance differences in the supply chain of the Australian agri-food industry.

1.4 Expected Contribution to Theory and Practice

As mentioned before, this study combines the insights of organizational theory, supply chain management, and institutional economics to develop a model of supply chain performance using the principles of resource-based, knowledge-based and the transaction cost theories (Barney 1991; Grant 1996; Williamson 1975). The hypotheses of this model are to be tested with structural equation modeling. Researchers have argued that a differential mix in a model from a separate stream of literature can lead to the most efficient outcome (Klein *et al.* 2005; Lazzarini and Zenger 2002). Therefore, the current approach is expected to make a unique theoretical contribution as very few empirical studies have investigated the cumulative influence of organizational theories and new institutional economics in identifying the important performance factors in the agri-food industry supply chain. Moreover, in this study a distinctive approach will be initiated to study inter-firm relationships and knowledge management (KM) practices in the agri-food industry supply chain by developing the structures and elements of inter-firm relationships and supply chain knowledge assets. Currently, studies focus on KM practices for building a dynamic supply chain or in a particular function of SCM in manufacturing industries such as in logistics. But this study was designed to explore KM in all the stages of the agri-food supply chain. Further, this study will investigate a combination of structural, economic and behavioral climate of the buyer-seller relationships in the supply chain performance, which is a unique approach as in previous literature they have been investigated separately.

In practice, it is expected that the outcome of this study will contribute to an enhanced understanding of knowledge management and inter-firm relationship factors that drive the supply chain performance in the agri-food industry. As this study will investigate the combined effect of developing and utilizing knowledge assets, IOS application, and competent inter-firm relationship in SC performance, it will contribute to creating a sustained competitive advantage by suggesting better programs, policies and benchmarking for Australian agri-food companies. Also, it can provide appropriate directions for utilizing strategic internal resources and long-term vertical relationships in the supply chain. Thus, it can assist practitioners to get more insights at the operational level – in the sense of developing a more effective and efficient supply chain – as well as at the strategic level for supply chain policy, partnering and investment, which will have a positive impact not only on the agri-food companies but also other business sectors in Australia.

1.5 Structure of the Thesis

The presentation of the study is divided into nine chapters. This introductory chapter provides the background, research questions and objectives of the research. The expected contribution of the research is also briefly outlined here.

Chapter 2 establishes the background of the study by a theoretical underpinning from TCE, RBT and KBT. Based on the principles of these theories, insights from the relevant literature, and the identified gaps in the agri-food supply chain management, a conceptual preliminary research model is proposed in this chapter.

Chapter 3 provides the research methodology – the detail of the research processes and methods used to explore the research questions and fulfill the research objectives. This chapter covers how, by using a pragmatist research paradigm, a two-stage mixed method research is conducted; specifically an exploratory phase using a qualitative field study to enhance the preliminary theoretical model and develop the survey, and a confirmatory phase using quantitative survey to test the research hypotheses. This chapter discusses the adopted telephone survey methodology and the data analysis techniques such as partial least square based structured equation modeling.

Chapter 4 provides the results of the exploratory phase – the detailed interpretation of the findings of the qualitative field study. The purpose was to enhance the initial theoretical model (identified in Chapter 2) by exploring particular supply chains, concurrent ideas, and performance factors of the agri-food industry in real world conditions. Using the concepts from the theoretical frameworks, in-depth interview was adopted as the method of qualitative inquiry into eight firms who voluntarily agreed to participate in the study. NVivo 8.0 software was used to analyze the contents of the transcripts. It resulted in identification of some of the important factors and variables which are later incorporated within the framework of TCE, RBV and KBV to develop a combined model. The combined model provides the basis of a final research model and hypotheses discussed in Chapter 5.

Chapter 5 provides the final research model and 22 hypotheses to be tested based on the survey data. A detailed explanation and justification of the research model, higher order constructs and their measures (both formative and reflective) and the hypothesized relationships are provided, targeting the model in the specific agri-food industry – the Australian beef industry. The hypotheses were drawn to test the influence of independent factors (identified based on the combined model from literature review and results of the field study) in the supply chain performance and competitiveness.

After finalizing the research model and research hypotheses, Chapter 6 focuses on developing the questionnaire and its measures. The chapter also details the survey pretesting – a range of testing techniques prior to the actual survey aimed to identify and minimize the possible occurrence of survey errors for valid, reliable, and unbiased results. The pilot study, a trial version of the full scale telephone survey, is reported in this chapter as one of the methods of pretesting the survey instruments.

Chapter 7 presents the detail of the survey data analysis - assessment of both the measurement and structural part of the research model; thus reporting the outcome of hypotheses of this study (described in Chapter 5). Most of this chapter specifies how partial least square (PLS) based structural equation modeling, a confirmatory second-generation multivariate analysis technique, is used to analyze the data that were collected through a telephone survey of 315 firms.

Chapter 8 explains and interprets the results of testing the research hypotheses. It also discusses the implication of the results, the significance of each of the research factors/constructs in the performance and competiveness of the industry. Recommendations for benchmarking the supply chain issues are also provided in the discussion.

Finally in Chapter 9, conclusions from the research are drawn. It discusses how the research questions and objectives are fulfilled, and what the research limitations are. Then, the contribution of the research is summarized and possible future directions are outlined.

A list of references is provided at the end. The survey questionnaire and a number of useful documents related to this research are given in the Appendices.

1.6 Definition of Terms

Agri-food Industry: Refers to industries that are responsible for the production and distribution of grain, vegetable or animal-based products (Zuurbier *et al.* 1996).

Supply Chain Management (SCM): Refers to the processes where a series of integrated activities performs the functions of product development, manufacturing, procurement and distribution of finished goods to customers, and aftermarket support (Williamson, Harrison and Jordan 2004).

Agri-food Industry Supply Chain: Relates to all linkages from the primary producer of foods to the final consumer such as farmers/producers, wholesalers, processors, retailers and exporters (Bijman *et al.* 2006).

Inter-organizational System (IOS): An application system that links various partners in the supply chain using a public or private telecommunication infrastructure (Premkumar 2000).

Knowledge Asset Management: Deconstructing the larger concept of knowledge management, the term refers to the dynamic ability of creating and utilizing knowledge in the supply chain.

Transaction Climate: Refers to the structural/economic and the behavioral factors of governing a relationship such as reciprocal investment, contract choice, mutual trust and perceived bargaining power (Bensaou 1997).

Transaction cost: Refers to the “costs of carrying out any exchange, whether between firms in a marketplace or a transfer of resources between stages in a vertically integrated firm” (Hobbs 1996 p. 3).

Chapter 2

Literature Review and Preliminary Research Model*

2.1 Introduction

Performance evaluation of a supply chain (SC) has been a major research issue in contemporary management literature as companies increasingly are relying on the system efficiency of the SC as a source of competitive advantage (Cohen and Roussel 2005; Gunasekaran *et al.* 2001). Since the main objective of managing a SC is to increase the value of products and services, Supply Chain Management (SCM) has become a strategic weapon in a firm's success; one that can result in significant cost savings emanating from quick sourcing and upgrading a product, lower inventory and inter-firm transaction cost. The value created from SCM can be enhanced by improving the strategic issues of developing and governing the supply chain in a firm.

Researchers and practitioners have defined supply chain in a number of related ways (see for example Lee *et al.* 2002, Landeghem and Vanmaele 2002, and Ovelle *et al.* 2003). One common aspect of any supply chain, however, is the flow of products from its source (production plant, wholesaler etc.) to its destination (customers, retail stores etc.). Landeghem and Vanmaele (2002) identify three hierarchical levels of supply chain: operational, tactical and strategic. This research deals with a strategic supply chain and aims to investigate the antecedent factors of supply chain

* Part of this chapter has been presented at the following conferences:

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Inter-firm relationships and performance factors in the Australian beef supply chain: implications for the stakeholders, in *Proceedings of the Australian Agricultural and Resource Economic Society (AARES) National conference,* 10-12 February, 2010, Adelaide.

Uddin, M.N. 2009. Impact of inert-organizational relationship and knowledge Asset development in supply chain performance: a qualitative inquiry in Australian agri-food Industry in *Curtin Business School Doctoral Students' Colloquium 2009* – Curtin University of Technology, Perth,

Uddin, M.N. and Quaddus, M. 2008. A theoretical insight of knowledge asset and transaction climate in the Agri-food Industry Supply Chain: Perspective of Australia, In: *17th Annual IPSERA Conference, 9-12 March 2008, Perth, Australia.*

performance in the Australian agri-food industry. To this end, this study adopts the operational definition of supply chain as "a set of networked organizations (stakeholders) working together to source, produce, and distribute food products to the customers" (Lee *et al*. 2002, p. 375). Supply Chain Management (SCM) is also defined as the integrated management of a group of firms that starts with the suppliers' suppliers and ends with the customers' customers for the production and delivery of goods or services to the final consumers (Lee and Ng 1997).

Drawing on the theoretical grounds of Resource-Based View (RBV), Knowledge-Based View (KBV) and Transaction Cost Economics (TCE), this chapter provides a review of past studies to argue that competitive performance of an industry depends on improving cost efficiency across the whole supply chain and the underlying relationship and knowledge flows among stakeholders in the industry. The following sub-sections provide details of the supply chain in the Australian agri-food industry, the performance issues and the theories that make up the basis of a conceptual framework as proposed herein.

2.2 Supply Chains in the Agri-Food Industry

The term agri-industry refers to both farm and non-farm sectors such as manufacturing, wholesale, retail and export and is linked to the firm for the flow of goods and services (Islam 1997). But this study is confined mainly to the agri-food and food processing industry that processes agricultural products for public consumption or use as ingredients for further processing for human consumption. The food company and its supply chain are involved mainly with organizations that are responsible for the production and distribution of grain, vegetable or animal-based products (Zuurbier *et al.* 1996). The industry encompasses the preservation of agricultural products such as semi-dried products or finished products after initial or intermediate processing. Vandervorst *et al.* (2002) distinguish two types of food industry:

i. Supply chains for fresh agricultural products such as vegetables, flowers, fruit, etc where the chain members are comprised of growers, wholesalers, importers, exporters and retailers. The main processes involved are handling, storing, packing, transportation and trading of the goods without touching the intrinsic characteristics of the product grown.

ii. Supply chains for processed food products where agricultural products are used as raw input in the chain for producing consumer products with an added value of conservation and conditioning to extend the food shelf life, such as snacks, desserts, canned food etc.

The supply chain management of the agri-food industry relates to all the linkages from the primary producer of foods to the final consumer to optimize the business processes within and between the firms such as production and logistic processes, information exchange and consumer responses (Bijman *et al.* 2006). Usually, the chain is involved with high risk and uncertainty because of seasonal variations, the perishability of raw materials and consumer cultural trends that affect the production and consumption of food (Fritz and Canavari 2007). Access to product and pricing information from various sources is also affecting consumer preferences pressurizing the food producers for variety, quality and safety which, ultimately is affecting how the industry is organized, develops a governance structure and partners relationships for buying and selling arrangements; i.e., transactions in the supply chain. It requires a radical change to transform production-driven supply chains into market-driven supply chains, which is sometimes called a 'chain reversal' where a set of interdependent companies work closely together to manage the flow of goods and services along the food supply chain (Folkerts and Koehorst 1997). For example, some consumers can be sensitive to specific attributes of agricultural products which may require the integration of downstream information on market preferences, and require special arrangement for processing and packaging of food according to the local and religious choices such as Halal meat preparation (Jongen and Meulenberg 1998). From the perspective of business environments and product characteristics, the agricultural industry supply chain differs from the manufacturing industry. In manufacturing, production usually can be scheduled with relative precision, and volume of output can be known in advance. But the output and quality of agricultural products rarely can be known in advance because of the weather, natural growing variation and sometimes for the inconsiderate action by the partners; for example, storing a unit load of milk on a dockside in the burning sun substantially can decrease the quality and quantity of the product (Schroeder and Hope 2007;

VanderVorst *et al.* 2002). A list of important issues related to the food supply chain is shown in Table 2.1.

Table 2.1 Issues in the Food Supply Chain

	Fresh Produce	Meat	Grain	Dairy
Product Characteristics	Perishable, seasonal, and noncontinuous production	Batch production	Changing qualities due to varying production conditions	Milk: continuous production
Governance	Short-term Contracts, Long-term relationship	Repetition of short term contracts between same partners	Mostly long term relationship with mutual bindings, investments and cooperation; seldom contracts	Mostly cooperatives; also contracts; also spot market mediated by trader
Market Characteristics	Buyer's market, small margins	Increasing prices	Decreasing Prices	Decreasing prices

Source: Adapted from Fritz and Canavari (2007)

Another feature in the food supply chain is that most agricultural product sales and distribution are carried out through sporadic auctions or less involving regulated markets in the form of a horizontal cooperative which often reduces direct interaction between buyer and seller, producer and processor (O'Keeffe 1998). A study by Weele (1988) found that almost 70 percent of the production value in the food processing industry is due to the costs of raw materials; therefore it is vital to develop a direct relationship with growers and suppliers to guarantee supply of the right raw materials in the right time to utilize the food processors' full processing capacity. Moreover, the increased concern of consumers about food safety and environmental issues increases the necessity for integrated quality control systems and associated tracking and tracing systems of goods in the supply chain (VanderVorst 2002). It may require greater emphasis on downstream information flows concerned with hygiene, safety and quality requirements that are important to develop consumer trust (Szabo and Bardos 2005).

However, the literature on agri-food supply chains can be divided into three streams (Bijman *et al.* 2006). One stream focuses on SCM to optimize supply chain processes within and between the participating firms and studies the whole chain, not just dyadic parts of it. The second stream is the economic organization approach mostly following transaction cost theory and the method of vertical coordination to analyze and design the most efficient structure of supply chain transactions (e.g., Hobbs 1996, 2000; Menard and Valceschini 2005).The third stream is the network approach focusing multidimensional relationships among firms including those companies that are not part of the supply chain such as accountancy, advisory services, equipment providers, etc.

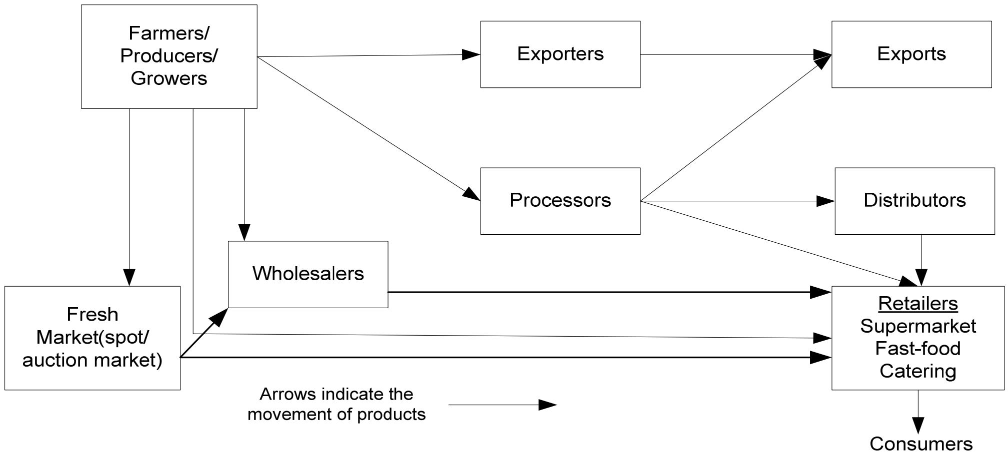
2.3 Issues in Food Supply Chains in Australia

As stated earlier in Chapter 1 Section 1.1, food industry is a major component of the Australian economy generating export income of around $24 billion a year (DAFF 2009). But the value of the export has been mostly declining since 2001-02 which is around 10 percent lower in 2007-08, although the industry is still contributing to an export surplus of $14 billion over food imports in 2007-08 (DAFF 2009). Meat and grains consistently have been the two largest sectors, with meat exports accounting for 28% (down from 30.5% from previous year) and grains accounting for 18 per cent of the value of food exports in 2007-08 (DAFF 2009). The major factors affecting the food and agricultural processing industry with a comparative decline in the performance have been identified as export competitiveness and market development issues (DAFF 2009; Spencer and Kneebone 2007) such as less cost competitiveness, low levels of labour productivity, and fragmented supply sectors.

Traditionally, the Australian agri-food supply chain has been dominated by auction systems and regulated markets, which means the buying and selling of the products are conducted without prior commitments placed on producers, and with little control over the commodities by buyers. From the auction/spot market, producers do not gain any insight of their customers as they are isolated from rest of the food chain. Likewise, processors lack innovative initiatives to develop the buyer-seller relationship with the producers while a low trust environment often exists and causes companies to fail in business performance (O'Keeffe 1998); for example, Simplot-Australia's Manjimup potato processing plant failed primarily due to inadequate relationship mechanisms with the growers and the resulting inadequate supply of raw materials (Islam and Johnson 2003). In addition, Australian food companies typically have limited or no R&D capabilities, with fragmented and often duplicated research services, which is also causing a lack of innovation in gaining competitive advantage

(DAFF 2009; Spencer and Kneebone 2007). Figure 2.1 shows a generic product flow in Australian agri-food chain drawn from the literature.

Figure 2.1 Generic Product Flow in Australian Agri-Food Supply Chain



The supermarket retail channel is the dominant distribution channel for the domestic food and beverage market in Australia, although the growers now increasingly are having a greater variety of alternative methods for selling their produce; e.g., selling directly to the public or electronically online and subcontracting delivery to other parties. The use of private treaty is becoming popular for selling fruits and vegetables, although auction is still the popular method for selling livestock. Major chain retailers have large national store networks, through national (NDC) and regional distribution centres (RDC), covering all inner city, suburban and regional centres and are well integrated with information that allows ready analysis of the changes occurring in supply and demand. On the other hand, independent banner groups and smaller chains have much less comprehensive coverage of the market, have a minority share of retail sales and are poorly serviced with information (Spencer and Kneebone 2007).

However, compared to other sectors in the Australian economy, the structure, composition and performance of the agri-food sector is under increased pressure because of the continuing changes in domestic and international food markets. The increased awareness of consumers on a healthy diet, rising commodity prices, and increased competition associated with globalization, driven by large multinational food manufacturers and supermarket chains that have the ability to source their input requirements from many different countries, are putting greater pressure for change on both Australia's domestic and export-oriented food sectors. Table 2.2 summarizes the pressure points in the Australian food industries.

Table 2.2 Pressure Points in the Agri-Food Supply Chain

Pressure Point	Meanings/Descriptions
Cost Competitiveness	Due to economies of scale, high costs of inputs and inefficiencies in production methods primary producers and processors in some sectors of the industry are less competitive against imported fresh and processed food.
Fragmented supply sectors	Due to the lack of a channel marketing approach, some sectors are suffering from a general lack of market knowledge and limited collaboration in managing supply chain information.
Weakened demand signals	Certain categories of supply chains, especially those in smaller to medium-sized business and dealing through intermediaries, are characterized by poor information flows and market visibility. Therefore, they are incapable of matching changes occurring in the market and demand.
Stronger positions of intermediaries	The structures of supply chains in some sectors allow the intermediate traders, wholesalers or agents to take margins greater than the value they add from primary producers.
Reduction of supply chain costs	Major supermarkets have been focusing on reduction of the costs of their supply for gaining performance, which has compelled a greater onus for the upstream suppliers to balance the cost of production.
Value/margin capture	With the increasing competition 'closer to the consumer' the possibility of getting greater value early in supply chains (producers' firm) is resisted, unless creating of alternative markets for the direct marketer supply chain.
Shelf-life performance	Shelf-life of food products is critical for greater sales and competition but has increased the pressure on fresh, perishable standards and caused higher levels of wastage to be costed into margins that are sought from suppliers.

Source: Adapted from Spencer and Kneebone (2007)

The table shows how the increased pressure of cost competitiveness, globalization and reduction of supply chain costs by downstream retailers and the strong position of intermediaries are affecting the performance of Australian food supply chain. Therefore, it has been argued that to build a better understanding of the supply chain performance factors including the market, the range of buyer segments, the value-added costs, and the multi-level supply chain relationships and information management are critical enablers to improvement of the agri-food industry in Australia (Spencer and Kneebone 2007).

2.4 Theoretical Background

Organizational and economic theories have emerged to explain why some firms successfully create core competencies and capabilities to improve their performances and competitiveness. For supply chain analysis, Hobbs (1996, p. 15) argued that "aspects of marketing, economics, logistics and organizational behavior are all important for developing insights into how and why different supply chain management arrangements emerge and for understanding the consequences of these arrangements for industry efficiency and competitiveness". A theoretical framework enables predictions to be made of any business activities and, therefore, it is always helpful to have a theoretical foundation within which the testable assumption can be drawn. It is for these reasons the principles of resource-based view (RBV), knowledge-based view (KBV) and transaction cost economics (TCE) have been used for this study to develop testable hypotheses about the antecedents and consequences of managing the supply chain in the Australian agri-food industry. The following sections describe the three theoretical frameworks on which this research is based.

2.4.1 Transaction Cost Economics (TCE)

The seminal work of Coase (1937) provided the basis of TCE; that there are costs to using the market transaction and to minimize them firms should understand the governing forces of their economic activities. The pioneering work in developing TCE was later carried out by Williamson (1975, 1979) and then a body of theories based on transaction costs emerged (Hobbs, 1996). TCE focuses on the inter-firm exchange process which creates transaction costs. To minimize these costs an efficient governance structure/inter-firm relationship must be set up (Coase 1937, Hobbs and Young 2000; Szabo and Bardos 2005; Schulze, Spiller and Theuvsen 2006; Loader 1997; Williamson1975, 1985). Transaction costs refer to the "costs of carrying out any exchange, whether between firms in a marketplace or a transfer of resources between stages in a vertically integrated firm" (Hobbs 1996, p. 3). They are simply the costs of: i) searching for information on potential buyers or sellers and prices of the product; ii) negotiating the physical act of transaction such as writing contracts, hiring lawyers, investment in technologies and paying for services of intermediary auctioneers or brokers; and iii) monitoring or enforcing pre-agreed terms of transaction such as ensuring quality of goods and behaviour of the parties. These costs of business may increase depending on the following key concepts of TCE (Hobbs 1996; Grover and Malhotra 2003):

i. Information Asymmetry and Opportunism: Drawing on the economics of information literature (Akerlof 1970), TCE explains that if business exchanges are characterized by incomplete, imperfect or asymmetrical information between the parties, they all face uncertainty and opportunistic behaviour driven by the self interest of the party who possesses private or hidden information prior to a transaction. For example a seller may know of defects in the quality of a product which is not available to a buyer.

ii. Bounded Rationality: TCE suggests that in the situation of complexity or uncertainty, the ability by people to make rational decisions is impeded because of the limitation of accurately evaluating all decision alternatives or because of the availability of incomplete information. Therefore, business in the agri-food industry can be driven by high uncertainty, seasonal and weather conditions and variations in production which impose extra costs of transaction.

iii. Asset Specificity: It refers to the relation-specific investment made by one partner that has no value if the relationship is ended. For example, the investment of a buyer made to the management of a supplier for production or for installing machinery unique to that supplier.

There are many forms of transaction costs; therefore, the range of those governance mechanisms that coordinate the exchange of goods and services is also wide. Vertical coordination[1] is one of the ways to minimize transaction costs, which can be viewed as a continuum where the beginning starts with spot markets at one extreme (such as auction markets or stock markets where price is the sole determinant of transaction with minimum coordination), then formal written contracts, strategic alliance and

[1] Vertical coordination includes "all the ways of harmonizing the successive vertical steps of production and marketing. The market-price system, vertical integration, contracting, cooperation singly or in combination are some of the alternative means of coordination" (Mighell and Jones 1963, p. 1).

relational partnerships to vertical integration at the other extreme. The level of this vertical coordination depends on the degree of uncertainty (environmental, political, social or economic risks), asset specificity and the frequency of transaction which also influence the transaction costs. TCE posits that the inter-firm governance structure and relational mechanisms are derived from economic rationality such that when transaction costs of using a spot or open market system rise, it is efficient to carry out the transaction by a strategic alliance or by vertically integrating the firms for synchronized economic activities through within-firm managerial direction (Hobbs 1996, Szabo and Bardos 2005). It is important to note that the word transaction does not indicate the movement of a finished product from a production line to the loading dock because it is coordinated within the firm managerial direction. Between the market and vertical integration, Williamson (1991) and Macneil (1980) provided another mode of governing transaction – termed as 'hybrid/relational' which is to form a tighter link between firms at adjacent stages of the value adding processes by preserving the ownership autonomy, unlike what occurs in vertical integration (Son, Narasimhan and Riggins 2005). This form of relationship has been described variously in the literature as value-adding partnerships (Johnston and Lawrence 1988), networks, vertical quasi-integration (Blois 1972), strategic networks and alliances (Heide 1994).

Thus, combining the new institutional economics and the concept of supply chain management for exploring the behavior of different supply chain participants, TCE provides an explanation of different modes/forms of organizing inter-firm relationships for efficiency and economies of transaction, and provides the methods of vertical coordination in different phases of the relationship (Szabo and Bardos 2005; Loader 1997). Therefore, the theoretical principles of TCE provide a natural fit for studying different forms of agri-food industry supply chains and analyzing their coordination mechanism such as the vertical coordination for information and knowledge sharing and their influence in the performance of the supply chain (see Premkumar 2000; Son, Narasimhan and Riggins 2005; Szabo and Bardos 2005; Hobbs 1996).

TCE explains that in a world where business activities and decisions are subject to bounded rationality and opportunistic behavior, the choice of a particular/different mode of organizing the supply chain is crucial for economizing on transaction costs. It also implies that the level of contractual/relational norms will influence the transaction costs significantly. Table 2.3 summarizes the Williamson (1985) suggestion of the contracting/relationship building process. The Table suggests that:

i) In a situation where bounded rationality is absent (full rational judgment is assumed) but opportunism and dedicated inputs (such as asset specific investment) are present, then the relationship should be built with rational planning by taking all the relevant issues of business to be settled in an accurate and effective contract.

ii) When opportunism is absent, judgment limited (for the lack of information) and relation specific investment present, then relationship can be based on promise emanating from the complete trust and honesty of the parties.

iii) When limited judgment and opportunistic behavior is present without any dedicated inputs, it is assumed that parties are not interested in stable or long-term relations where competition in the market should settle the transactions and any disputes.

iv) In the case when limited judgment, opportunism and dedicated inputs all occur at the same time, the rational and cognitive planning will not work, promise will break down and competition will not persist because of inappropriate rent from asset specific inputs. Therefore, internalization of the contracts is required for internal governance of the relationship.

Table 2.3 Attributes of Inter-Firm Contracting Process

Behavioral Assumption			Implied Contracting Process
Bounded rationality (limited judgment)	**Opportunistic self-interest**	**Dedicated inputs (asset investment)**	
O	+	+	Rational planning – taking an informed account of the relevant issues and potential problems
+	O	+	Promise – based on complete trust and honesty of the parties
+	+	O	Competition - the market will overcome potential problems
+	+	+	Internal governance – internalization of contracting
Notes: + implies the factor is present; 0 indicates the factor is not present.			

Source: Adapted from Banerjee (2004); Loader (1997); Williamson (1985)

According to Williamson (1985), for efficient governance of inter-firm transactions, three main structures emerge such as: market, trilateral, and bilateral/unified governance, which is classified based on the input/investment characteristics and the number of transactions between the parties. Table 2.4 summarizes the governance structure with a self-contained explanation (Williamson 1985).

Table 2.4 Efficient Governance Structures Based on Different Dimension of Inter-Firm Transactions

	Efficient governance structure		
Volume of Transaction	**Non-dedicated input**	**Input Characteristics Mixed**	**Dedicated input**
Few	Market [a] (classical contracting) e.g., purchasing standard equipment	Trilateral [b] (neoclassical) e.g., purchasing customized equipment	Trilateral (neoclassical) /unified governance) e.g., constructing a plant
Many	Market (Classical contracting) e.g., purchasing standard material	Bilateral (relational contracting) e.g., purchasing customized material [d]	Unified governance [e] (relational Contracting) e.g., site specific transfer of intermediate product across successive ranges

Notes

a. Market governance implies that alternatives are available from market which protects each party against opportunistic self interest or dishonesty by the opposing party to the contract.

b. Trilateral governance is built with safeguard and third party assistance with identified arbitration in resolving disputes and evaluating performance.

c. Neoclassical contract law relieves parties from strict enforcement, applies to contracts in which the parties to the transaction maintain autonomy but are bilaterally dependent to a nontrivial degree. A recognition that the world is complex, the agreements are incomplete, and that some contracts will never be reached unless both parties have confidence in the settlement machinery (Williamson 1985, p. 70; Williamson 1991, pp. 271-272).

d.. Bilateral governance/relational contracting indicates continuing contractual contract, but with the autonomies of the parties maintained

e. Unified governance implies internationalization of the contracting process.

Source: Adapted from Loader (1997); Williamson (1985)

To summarize, TCE provides an appropriate frame and starting point for the exploration of reasons for the market participants' behavior and the efficiency of transactions within the given institutional frames and provides insight into the development of closer inter-firm relationships in the agri-food industry (Szabo and Bardos, 2005; Hobbs and Young, 2000). For example, Loader (1997) illustrated the possibility of using TCE as a basis for a detailed diagnostic investigation of individual relationships within agricultural marketing systems and explored the implications of such relationships for supply chain structures and integration. Schulze, Spiller and Theuvsen (2006) investigated which form of vertical organization might be the most efficient structure for the German pork industry as suggested by TCE and provided empirical evidence on farmers' attitude towards contracts. In a similar study, Szabo and Bardos (2005), based on TCE predictions and economics of contracting, presented an empirical analysis of the key determinants of governance structures between farmers and dairy processors in Hungary. Hobbs (1997), from a survey of UK farmers, estimated the relative importance of various transaction costs in the choice of marketing channel and explained how information, negotiation and monitoring costs arise in a transaction can influence the vertical coordination outcomes. Banerjee (2004), by examining the Australian sugar supply chain activities from the perspectives of transaction cost economics, explored the types of transaction costs in the supply chain to develop relationships and trust for improving competitiveness in the supply chain.

2.4.2 Resource-Based View (RBV)

Resource-based view (RBV) has addressed the most fundamental challenge of organizational survival: what gives rise to competitive advantage and how it can be sustained (Srivastava, Fahey and Christensen, 2001). The proponents (Barney 1991) of the theory argue that firm assets and capabilities lay a foundation for competitive advantage and are primary predictors of superior performance (Barney 1991). “The resource-based view perceives the firm as a unique bundle of idiosyncratic resources and capabilities where the primary task of management is to maximize value through the optimal deployment of existing resources and capabilities, while developing the firm's resource base for the future” (Grant 1996 p. 110).

RBV is based on two underlying assertions as developed in strategic management theory (Barney 1991; Wernerfelt 1984): (i) the resources and capabilities possessed by competing firms may differ (resource heterogeneity); and (ii) these differences may be long lasting (resource immobility). Thus, RBV assumes that a firm’s performance is founded on its capabilities; i.e., its resources and the competitors’ difficulty in imitating them. Resources must be valuable, heterogeneous and immobile (Barney 1991). That is, they must provide benefits (reduced costs or increased revenue), be owned exclusively by the firm and be costly or impossible to imitate. An individual resource can be a source of competitive advantage only if it meets all the above three criteria (Zhuang and Lederer 2005).

Hunt and Lambe (2000, p. 20) explained that “resource heterogeneity means that each and every firm has an assortment of resources that is at least in some way unique. Imperfectly mobile implies that firm resources, to varying degrees, are not commonly, easily or readily bought and sold in the marketplace (the neo-classical factor market). Because of resource immobility, resource heterogeneity can persist through time, despite attempts by firms to acquire the same resources of particularly successful competitors”.

In advocating the RBV, Barney (1991) argued that a firm’s resources lead to competitive advantage and Collis (1994) claimed that various firm capabilities are a source of competitive advantage. Similarly Amit and Schoemaker (1993) showed that capabilities often are developed in functional areas (e.g., brand management in marketing) or by combining physical, human and technological resources at the corporate level. They further asserted that “resources, information and people are combined and sequenced over time in order to evolve specific capabilities” (Amit and Schoemaker 1993, p.39). Grant (1991) also supported the framework by identifying resources and capabilities as the foundation for a firm's strategies and argued that capabilities depend on resources.

Resources that are sources of sustainable competitive advantage and superior profits are called strategic assets (Amit and Schoemaker 1993; Barney 1991). RBV defined firm resources as "all assets, capabilities, organizational processes, firm attributes, information, and knowledge controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness" (Barney 1991, p. 101). Strategic assets are resources that are simultaneously valuable, rare, imperfectly imitable and non-substitutable (Barney 1991) Hunt and Morgan (1995, p. 11) added that resources are "any tangible or intangible entity available to the firm that enable it to produce efficiently and/or effectively a market offering that has value for some market segment(s)". These definitions provide a broad view of resources that embraces all assets and capabilities and focus on tangible and intangible firm assets as an input to gain competitive advantages; although some research shows that strategic assets are mostly intangible such as contracts employee know how, brand name, product reputation, culture etc. in the sense of being not easily imitable or purchasable compared to tangible physical resources such as property, plant and equipment (Michalisin, Smith and Kline 1997).

According to RBV, resources can be classified into three categories (Barney 1991):

i. Physical capital resources (Williamson 1975) such as technology, manufacturing capabilities, networks,

ii. Human capital resources such as experience, intelligence, training, judgment of employees in a firm, and

iii. Organizational resources such as research and development capabilities, formal reporting structure, controlling and recording system as well as informal relations among firms.

To have the potential of competitive advantage and sustained competitive advantage RBV suggests that a firm's resources must have four attributes:

a. they must be valuable in the sense that they exploit opportunities and/or neutralize threats in a firm's environment,

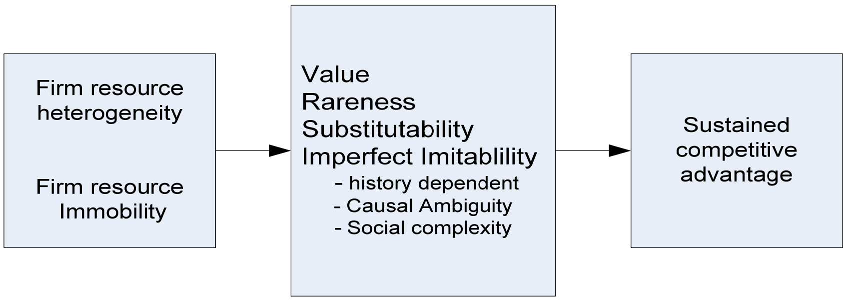
b. they must be rare among a firm's current and potential competition,

c. they must be imperfectly imitable, and

d. there cannot be a strategically equivalent substitute for the resources (Barney 1991).

Barney (1991, p. 102) defined sustained competitive advantage: "a firm is said to have a sustained competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefit of this strategy" (see Figure 2.2).

Figure 2.2 Relationships between Resource Heterogeneity, Immobility and Sustained Competitive Advantage



Source: Barney 1991, p. 112

The RBV distinguishes between resources that can be acquired in factor markets and those developed inside the firm. To confer competitive advantage, resources must not be homogeneous in implementing the same technologies or strategies in all the competing firms; however, resources that are heterogeneous, imperfectly mobile and asymmetrically distributed amongst rivals can provide competitive advantage and superior performance (Barney 1991; Hunt and Lambe 2000).

On the other hand, resource heterogeneity and immobility alone do not guarantee sustained competitive advantage; it can be gained only when competitors have difficulties in perfectly imitating or acquiring the resources. Imperfect limitability results from: i) historical circumstances (buying a piece of property later provides a locational circumstance, ii) casually ambiguous resources, and iii) socially complex resources that refer to organizational beliefs, values and cultures practiced by individuals or groups in the firm environment (Barney 1991, Hunt and Lambe 2000).

The RBV emphasizes that firms should focus on developing their internal resources/assets and processes as they are the primary predictors of superior financial performance. For example, based on the insights of RBV, Zhuang and Lederer (2005) examined the effects of human, business and e-commerce technology resources on firm competitiveness and found that business and e-commerce technologies are the good predictors of firm performance. Therefore, firms should acquire the processes that are inimitable and leverage core resources for sustained competitive advantage (Grant 1991; Kearns and Lederer 2003). The works on RBV range from the early works of Penrose (1959), Lippman and Rumelt (1982) and Wernerfelt (1984). In the 1990s, the nature, foundation and application, as well as implications of the theory were developed by Barney (1991, 1994) and many others (e.g., Barney and Hansen 1994; Collis 1994; Grant 1991; Mahoney and Pandian 1992; Madhok 1997). However the continued theoretical development of RBV suggests not simply correlating the aggregate measures of resources at the firm level for firm performance indicators but rather the need to investigate where resources reside. Thus theoretical and empirical attention should be aimed at the level of resources, not at the level of the firm (Barney and Mackey 2005; Hult *et al.* 2006). For example, building on the notions of RBV, Hult *et al*. (2006) provided empirical evidence that capitalizing on knowledge elements/resources can create performance in supply chains only if there is a relative fit with the organization's strategy. In another study, Hult, Ketchen and Arrfelt (2007) found evidence that neither a culture of competitiveness nor knowledge development as a resource by itself is sufficient to achieve superior performance in different market conditions; instead they operate in tandem to achieve desired outcomes.

In terms of the practical application of RBV, Barney (2002) later provided a VRIO framework, as shown in Table 2.5, where he added an organizational focus (by policies, procedures, leadership) for the exploitation of its valuable, rare and costly to imitate resources. The framework can be explained by the response to a series of four questions where he said if a resource is only valuable it leads to competitive parity;

both value and rarity are required for a temporary competitive advantage; while all the elements, e.g., value, rarity, inimitability and organizational focus are needed to develop and sustain the competitive advantage.

Table 2.5 VRIO-Framework

Is a resource or capability …					
Valuable?	**Rare?**	**Costly to imitate?**	**Exploited by organization?**	**Competitive implications**	**Economic performance**
No			No	Competitive disadvantage	Below Normal
Yes	No			Competitive parity	Normal
Yes	Yes	No		Temporary competitive advantage	Above normal
Yes	Yes	Yes	Yes	Sustained competitive advantage	Above normal

Source: Barney 2002, p. 173

2.4.3 Knowledge-Based View (KBV)

Building on the same notion of resource attributes in the RBV - value, rarity and inimitability, knowledge-based view (KBV) provides the basis of sustained competitive advantage which is the ability of a firm to develop rare and valuable knowledge through learning, and subsequently to build upon and spread that rare knowledge throughout the organization for enhancing performance (Dierickx and Cool 1989; Nonaka 1994; Bogner and Bansal 2007). Grant (1996) provides a more general knowledge based approach to the firm by explaining that knowledge is the most strategically important resource of a firm, and unique abilities to create and exploit knowledge enhance organizational innovations and outcomes (Grant 1996; Hult *et al*. 2004, 2007). KBV also focuses on the nature of coordination within the firm and provides implications for the organizational structure and hierarchy of decision making.

A fundamental premise of KBV is that characteristics of organizational knowledge are heterogeneous and, therefore, the organizational context within which the knowledge creation and transfer occurs is an important source of competitive advantage (Szulanski 1996). Because the sources of context-specific knowledge facilitate the integrative process of creating collective experience they can be a valuable input for the performance of a firm (Roth and O'Donnell 1996; Taylor *et al.* 1996).

The theoretical underpinning of the KBV has been developing for decades (e.g., Penrose 1959; Spender 1993; Nonaka 1994, Grant 1996; Lockett and Thompson, 2004), while more recent theory has focused on the dynamic capability of learning and applying knowledge as strategic resources. It is becoming broadly accepted that the concepts of knowledge and knowledge management are tightly linked to competitive advantage and sustained firm performance (e.g., Simonin 1999; Zander and Kogut 1995; Bogner and Bansal 2007; Hult *et al*. 2004, 2007; Spender 1993).

The focus of KBV is mainly on the process of learning knowledge; it includes knowing how from tacit knowledge, and knowing about facts and theories from explicit knowledge. But complex issues lie between the two in relation to the transferability of knowledge within and between the firms. Grant (1996) discussed a number of characteristics for knowledge utilization: viz., transferability of tacit and explicit knowledge within and between the firms; efficiency of knowledge aggregation and generation; and the applicability of knowledge resources to solve unique problems, which requires coordination among the individuals who possess knowledge.

Therefore, the focal variables of the theory are related also to coordination mechanisms through which a firm integrates the specialized knowledge of its individual members (Harvey, Speier and Novicevic 1999). The assumption is that knowledge resides at the individual level and is utilized by the individual; therefore, the organizational capability depends on the efficiency of integration and transmission of tacit knowledge within the firm. Thus knowledge-based view (KBV) has provided much attention, treating knowledge as tangible and intangible resources for sustained competitive advantage within a firm and focusing on the types of knowledge, knowledge acquisition, storage, transfer, application, learning and specialization in knowledge within the boundary of a knowledge-based organization.

2.5 Application of Theoretical Perspectives in the Performance of Agri-Food Industry Supply Chain

As the preliminary model for this research is drawn based on the principles of RBV, KBV and TCE, in this section the relevance of the theories to agri-food industry performance factors are detailed by identifying a gap in the current literature. The main goal in this section is to identify the important antecedent's factors/constructs that can influence the performance of the Australian agri-food industry supply chain to make a unique contribution to the improvement of the industry.

2.5.1 Inter-Firm Transaction Climate in Agri-Food Supply Chain

Business transactions are conducted in interactive communication processes between two partners, seller and buyer, and their decisions upon the continuation of the transaction process (Sto¨lzle 1999). Therefore, a large part of SCM literature consists of managing competent inter-firm or inter-organizational relationships such as alliances or partnerships in the supply chain to gain competitive advantage in cost minimization, ensuring product quality and customer satisfaction. Relationships in the supply chain may range from single transactions to complex, interdependent relationships which may vary from arms length transactions (or market governance) to vertical integration with hybrid cooperative relationships (Contractor and Lorange 1988) among members (primary producers, manufacturers, wholesalers, retailers etc) involved in the production, delivery and selling of goods to consumers. Transaction variability usually depends on the levels of trust, commitment, mutual dependence, leadership and top management support; the higher the levels of transactions, the closer the firms are to an integrated relationship, superior business performance and more profit (Golicic *et al.* 2003). The relationship that explicitly leverages information technology for communication and transaction is described as 'Inter-organizational system' or 'Information partnership' (Konsynski and MacFarlan 1990). An efficient supply chain relationship can reduce the risk and uncertainties in transaction and can provide many returns such as lower product and/or services costs, better quality, innovation, responsiveness, enhanced technical support, fewer complaints and a better business reputation.

In determining the most suitable type of inter-firm relationship, the stream of literature on agri-food supply chain focuses on:

i) the degree of exogenous uncertainty, e.g., technology, competitors, regulatory groups etc. surrounding the transaction,

ii) the degree of endogenous uncertainty in the partnership which is structural/economic and indicative of the behavioural climate of the relationship, and

iii) the frequency of transaction.

Past studies have described the components of inter-organizational relationships in the political economy framework, which combines efficiency-based and socio-political approaches as complementary to explain the seller-buyer relationships in a social system that consists of "interacting sets of major economic and socio-political forces which affect collective behaviour and performance" (Stern and Reve 1980; Bensen 1975; cited by Nidumolu 1995, p. 91). Efficiency based approaches focus on cost and applies theories from microeconomics such as transaction cost economics (Coase 1937; Williamson 1975) to identify the most efficient governance structures for a transaction. Socio-political approaches such as resource dependence theory (Pfeffer and Salancik 1978) are drawn from organizational theory and social psychology and concerned with trust and power in the marketing channel. These theories argue that a firm initiates an inter-organizational link primarily to gain control over critical resources and reduce uncertainty in its transactions. The political aspect is identified by the extent to which decision-making is centralized in one of the dyadic partners (a two-firm relationship consisting of a seller and a buyer of goods or services), while the economic aspect is given by the extent to which the terms of trade are determined in a vertical relationship.

In this study the 'inter-firm transaction climate' concept is used to explain how synergies of the endogenous factors combining structural/economic and behavioural characteristics of governing a relationship, such as reciprocal investment, contract choice, mutual trust and perceived bargaining power, offer competitive advantage in the agri-food industries' supply chain and, ultimately, better firm performance. The concept 'transaction climate' was originally introduced by Reve and Stern (1976) to describe the sentiment existing between the parties making transactions. They focus on compatibility in goals, and fairness in sharing the risks, benefits and burdens equally in the relationship to reduce opportunistic behaviour and increase cooperation. Based on their work, this study combines the cumulative influence of the new institutional economics and sociological theory to demonstrate that all inter-firm transaction in an agri-food chain should be carried out within a specific set of formal and informal arrangements to obtain best value supply chain. Renewing the neo-classical paradigm of corporate economics, the new institutional economics uses a transaction cost perspective and focuses on formal arrangements such as property rights, contracts and authority; while sociological theory emphasises the role of informal institutions such as norms and social ties in governing transactions in the agri-food supply chain (Bijman *et al*. 2006; Powell 1990). It is argued that a differential mix and dynamic interactions between the two approaches may lead to the most efficient outcome (Klein *et al*. 2005). Table 2.6 provides a summary of the variables used in those studies of the food supply chain.

Table 2.6 Inter-Firm Relationship Variables in Agri-Food Supply Chain

Inter-Firm Relationship Variable	Main References
Trust	Clare, Shadbolt and Reid 2005; Duffy 2008; Lu *et al.* 2006; Fritz and Canavari 2007; WY and Associates 2009.
Power	Bunte 2006; Sodano, 2006; Szabo and Bardos 2005; Revell and Liu 2007; Cox 1999; Collins 2002.
Interdependence	Duffy 2008; Clare, Shadbolt and Reid 2005.
Contractual arrangement	Bijman, 2006; MacDonald et al. 2004; Schulze, Spiller and Theuvsen, 2006; Szabo and Bardos 2005; Hobbs 1996, 2000; Duffy and Fearne 2004.
Commitment	Clare, Shadbolt and Reid 2005; Duffy 2008; Jie, Kevin and Rodney 2007; WY and Associates 2009.
Symmetry	Clare, Shadbolt and Reid 2005; Duffy 2008; Bensaou 1997
Uncertainty	Hobbs 1996; Hobbs and Young 2000 Bensaou and Anderson 1999.
Risk	Duffy 2008; Jackson *et al.* 2007; Schiefer and Rickert,

	2004; Hornibrook and Fearne 2003; Fritz and Canavari 2007.
Conflict resolution	Duffy 2008.
Transaction Climate	Bensaou 1997; Nidumolu 1995, Duffy 2008.
Relation-specific investment	Collins 2002; Loader 1997; Williamson 1985; Han, Omta and Trienekens 2007; O'Keeffe 1998; Lu *et al.* 2006.
Cultural compatibility	Clare, Shadbolt and Reid 2005.
Coordination of work	Clare, Shadbolt and Reid 2005; Duffy 2008; Schulze, Spiller and Theuvse 2006.
Information Sharing	Clare, Shadbolt and Reid 2005; Schiefer, Helbig and Rickert 1999

2.5.1.1 Formal relationship

A competent arrangement of long-term formal relationships in an agri-food chain is directly related to competitive advantage and better firm performance; it may lead to reduced political, economic or social risk, reduced transaction costs and access to economies of scale by-passing traditional market arrangements (Loader 1997). In a supply chain relationship inter-firm transaction costs are important as they refer to the costs of contacts, control and contracting costs between firms in a marketplace or a transfer of resources between stages in a vertically integrated firm (Hobbs 1996). Cost also included a sunk cost arising from a broken contract which sometimes is very high if the relation specific investment is high. The costs rise because of information asymmetry, bounded rationality (decision making under partial information) and opportunistic behaviour among partners in the transaction relationship. A wide stream of literature in the agri-food supply chain, therefore, is based on the theory of Transaction Cost Economics (TCE) as it provides a natural fit to design the most efficient governance structure of a relationship; i.e., the methods of vertical co-ordination for a closer buyer-seller relationships in the food supply chain by explaining cost minimization issues and the effect of investments in relation specific assets.

TCE points to an economic organization approach for a better coordination across the firms' successive stages of production and marketing through which products move in the supply chain from production to consumption. It starts from the spot market or wholesale market via strategic alliances, joint ventures, different contractual agreements etc. to total vertical integration; and can be viewed as a vertical coordination continuum (Hobbs 1996). Full vertical integration occurs when one firm carries out two or more consecutive stages of the production-distribution chain (Hobbs 1996). However, the negotiation of product quality, delivery schedule and customer satisfaction also is extremely important, in addition to the cost minimization issues which requires more formal and integrated vertical relationship in the food supply chain. Therefore, based on the insight of TCE and other theories in the current study, focus is on the following formal arrangements for a vertical coordination in agri-food supply chain. These may offer competitive advantage in the flows of input, processing and distribution of products within-firm managerial orders rather than the direction of price in the spot market.

Relationship-specific investment

Relation specific investments catering to the special needs of primary producers and processors or processors and retailers are an important source of value creation in transactions. Investment makes the buyer-seller relationship closer and enhances business transactions (Lu *et al*. 2006). The nature of the food companies requires that they should make some investment to develop close ties with their primary producers for ensuring raw inputs; for example, investment for animals, feed and management services for a cattle firm. Investment may enable buyers to gain confidence; for example, investments in equipment such as a cooling van to transport products from suppliers to retailers' shops or technologies to improve food quality and safety may have a significant impact on the relationship. Investment in non-imitable intangible assets such as developing an inter-organizational information system with customized business processes or creating domain specific knowledge enhance companies' capabilities to conduct relation-specific transactions and can reduce the uncertainty of asset specificity; asset specificity refer to an investment in a production process made by one buyer or seller, thereby locking themselves into that relationship for a period of time.

From a TCA perspective, a firm that makes asset specific investments faces the risk of being exploited by its transaction partner as there is a high sunk cost to switch to other partners, while if the investments are non-specialized, the ability to switch to other partners is the investing firm's primary protection against opportunistic behaviour by its partners (Williamson 1985). Nevertheless, in agribusiness, particular relationship-specific investments can create exit barriers and reliance of the partners, especially when the investment is based on the focal firm's business process; domain knowledge specificity for managing growers' production or enhancing retailers' sales volume can strengthen the bargaining power of the food processor in transactions (Gosh and John 1999; Subramani 2004). Resource Dependency theory (Pfeffer and Salancik 1978) also suggests that, based on the specialized assets of goods or materials, some firms become reliant on others which are critical to reduce environmental uncertainty. The supply chain partners also may share investment costs by different contractual agreements or by long-term alliances which may reduce uncertainty of asset specificity and opportunism. The former is a 'close, fast developing, short-lived exchange' relationship (Lambe *et al*. 2000), whereas the latter is equity-based or strategic resources alliances (Colwell and Vibert 2005).

Contractual Arrangement

Agricultural contract refers to contracts "used to arrange for the transfer of agricultural products from farms to downstream users such as processors, elevators, integrators, retailers, or other farms" (MacDonald *et al.* 2004, p.3). Since agricultural markets become more differentiated, traditional spot or open market transactions cannot be an efficient means of managing the supply chain in food processing industries for their production and marketing of products. The quality and safety, as well as the required quantity of input, are the main pressures on contractual arrangements of the food companies so that they have more complete information and greater control on the sources of input for their products. For example, a meat processor may enter into a contracting arrangement with a cattle firm to gain additional control over animal production such as the animal genetic strain, how it is handled, whether it was fed organic grain, etc; all issues directly related to the quality, quantity and safety of the meat and not possible to estimate only by visual inspection of the animals. While contracting is more common in the dairy industries, it is also gaining preference in the vegetable, fruit, grain and meat industries with the increased use of value-enhanced grains or corns in products such as chips and cornflakes that have specific quality characteristics (Martinez and Davis 2002). A contract can be a formally written agreement or it can be informally arranged with only an oral negotiation especially when a strong social/cultural heritage and stable legal environment exist between parties.

Contracts should be a basic governance choice to allow a closer vertical coordination among the primary producers, processor and the retailers in a buyer-seller relationship in the agri-food chain; they can be structured based on the condition of transaction. For example, Hobbs (1996) noted:

i. A marketing contract can be formed when buyer holds the responsibility to provide a market for the seller's output with specification of agreement on price, quantity, quality, compensation, terms of delivery and the decisions over when the product is sold.
ii. A production-management contract may provide buyers more control to regulate the production process through inspecting and specifying input usage.
iii. A pre-financing or input-specifying contract may provide even more control to the buyer, in addition to the marketing and production supervision, where they supply key inputs to the seller such as seeds, animal feeds etc. and may own the product on a condition that the seller get paid based on the volume of output.

Contracts can be seen as devices to reduce price risk or the cost of transactions by using a spot market. However, there are some other non-contractible, non-financial aspects such as customer responsiveness, product innovation, technology acquisition, defect rate and reliability etc. on which TCE cannot flawlessly determine the most suitable type of transaction relationship as buyers cannot effectively claim the investment to suppliers by the way of a contract. Moreover, due to the information asymmetry or bounded rationality in inter-firm relationships, contracts are usually incomplete. Hendrikse (2003) stressed that incomplete contracts can become more complete by allocating control and authority to somebody who can decide on the changing market situations. Besides, buyers can take the initiative to support some incentives for investment on non-contractible factors to improve the supply chain to deal with changing customer needs.

2.5.1.2 Informal relationship

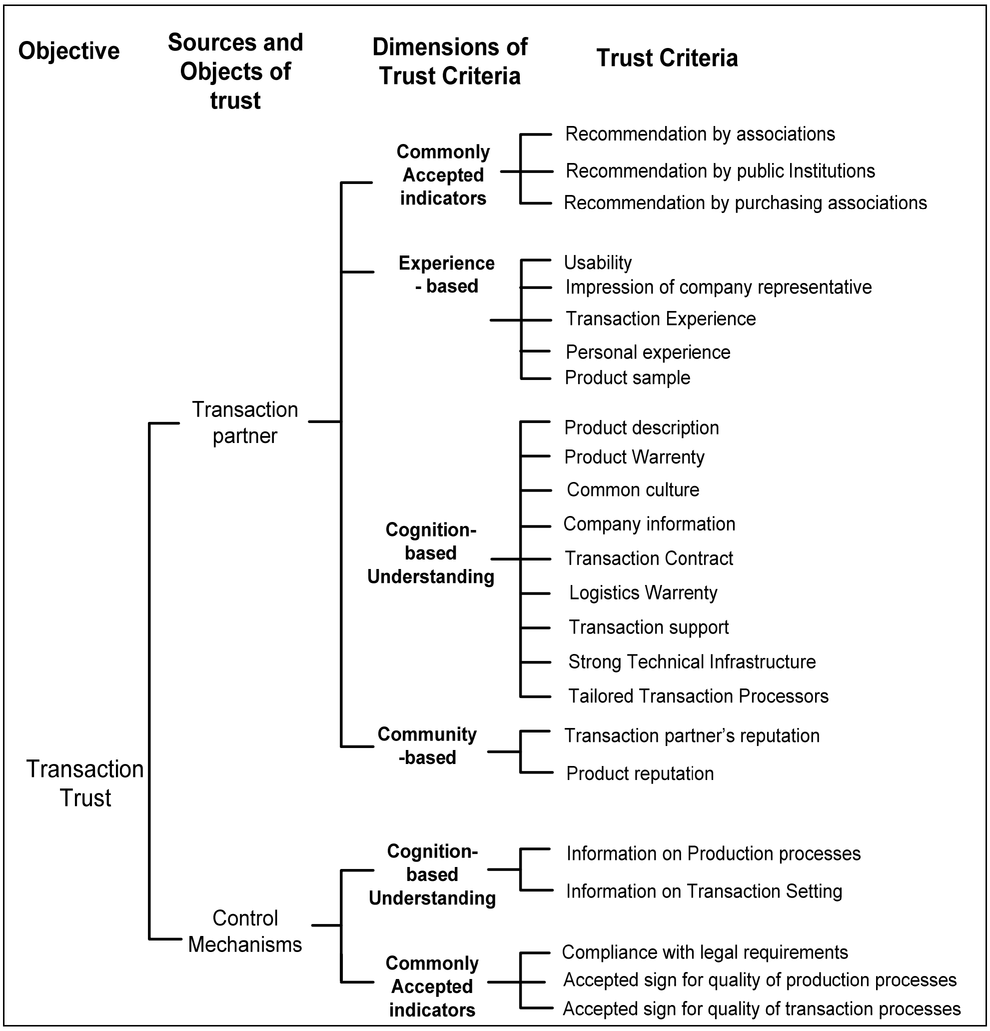
Direct personal experience and social ties/influence may have a significant role in minimizing transaction costs among supply chain members. The sentiments concerning relationships are well documented in the literature; for example, feeling of common goal compatibility, domain consensus and fairness consistently are reported to increase trust. It is also believed that exchange organization will be affected by power, assuming that economic exchange is embedded in social networks, where the members' behaviour has relational and normative dimensions (Fritz and Canavari 2007). Therefore, we focus on the effect of the following relationship aspects in the food supply chain.

Trust

In supply chain transactions, trust refers to the belief that an exchange partner is honest and reliable, and will not exploit other parties' vulnerabilities (Mayer *et al.* 1995). Trust between transaction partners is a crucial element in the food supply chain due to the fact of information asymmetry (partners do not possess the same level of information) on product characteristics, some of which may be analysed only after the consumption of food (experience characteristics) and some may not even be examined at all (credence characteristics). Most studies on supply chain trust, therefore, have focused on honesty and benevolence factors to measure trust based on the extent of the partnership role in fulfilling promised obligations as well as on the motivation in seeking joint gains and welfare by avoiding immediate self-interest (Andaleeb 1995; Anderson and Narus 1990).

A trusted relationship can be considered as a value creating economic asset because it lowers transaction costs by reducing the efforts of formal contracting and the costs of controlling and monitoring a transaction (Dyer and Chu 2000). Trust also may complement incomplete contracts. However, a lot of aspects are related to the decision on whether or not to trust a partner; factors such as individual personal contacts, prior business experience, commitment, communicating market information and reputation. A long-term business relationship based on past experience and interactions may reduce information asymmetry and cost of searching product-specific information. Fritz and Canavari (2007) provide some criteria relevant to generating partnership trust, as shown in Figure 2.3, which can be extremely helpful in generating trusted relationships in food supply channels.

Figure 2.3 Generic Trust Decision Model for Food Supply Chain



Source: Fritz and Canavari (2007, p.362)

Power

In a supply chain, power refers to the capability of one party to informally receive obedience from the other party through promise, threat, retaliation, reward or punishment (Sodano 2007). A retailer's power over a food company is positively related to the importance of economies of scale in manufacturing, retail concentration and own brand penetration of the market; the power increases as company specific investment increases and product quality increases (Collins 2002). Though it is argued that power should not be exploited in chain management because lean approaches should be based on equity, trust and openness (Cox 1999), some authors believe that power is associated with functional coordination that comes only through the emergence of a chain driver to increase sales, reduce costs and risk, and increase speed and reliability of the supply chain (Daviron and Gibbon 2002). The power relationship is important in a food supply chain because of the shift from competitive (i.e., spot markets and complete contracts) to imperfectly competitive environments made up of incomplete contracts and large farms where participants usually try to appropriate as much value as possible for themselves on the basis of their critical assets, controlling of resources or based on circumstances that give them bargaining or market power.

For example, in Hungary Szabo and Bardos (2005) showed that even though there is a written contract, food processors often arbitrarily change terms of contracts using their power and cause hold-up problems (exploiting the vulnerability with perishable products) for producers, who have relation-specific investments. They suggest that producers should come up with an organization (producers' groups, co-operatives etc.) to increase their bargaining power. Chains with overall buyer or supplier dominance are most likely to experience adversarial effects. A positive pro-active supply chain is only enforceable or likely to emerge when there is consistent direction in dominance or interdependence among the producers, processors, wholesalers and retailers throughout the chain (Revell and Liu 2007).

2.5.2 Knowledge Asset and Competitive Advantage in Agri-food Supply Chain

Knowledge can be treated as a resource, a competence and a capability to create valuable input to a firm and can contribute substantially as an intangible asset in the supply chain. It can be a strategic resource in a supply chain in a sense of 'knowing that' and 'knowing why' (Cohen and Bacdayan 1996) that provide access to inter-firm transactions and to markets of inputs and outputs, and subtlety, but determinedly, steer members toward satisfying customers' needs (Nooteboom, 2004). Knowledge is a competence in the sense of ‘know how’ or ‘procedural knowledge’ (Cohen and Bacdayan 1996) that provides authority to utilize resources in the supply chain, while capability indicates the ability to develop competencies to exploit the supply chain in agribusiness not just as procurement, production and distribution mechanisms, but also as an important competitive weapon to gain better firm performance (Hult *et al.* 2004). A paradigm focus on knowledge initiatives may create dynamic capability to employ new competencies and resources which, in turn, may provide innovation and speed efficiency of the supply chain and a competitive weapon or advantage for superior firm performance. Bogner and Bansal (2007) argued that sustained firm performance is related to well-developed capabilities which can be gained by i) developing either high impact or incremental new knowledge; (ii) using existing, internally developed knowledge as an input to build subsequent new knowledge; and (iii) appropriating long-term rents from inventions by developing subsequent inventions.

Thus, theories about firms have emerged to explain why some firms differ in creating core competencies, capabilities and their performance (e.g., Coase 1937; Williamson 1975; Barney 1991). Relying on the R-B and K-B theories, many authors contend that knowledge creation, knowledge management, firm-level learning and other similar approaches are at the heart of gaining sustained competitive advantage (Grant 1996; Pitelis 2004). Firms can pursue two different aspects of intellectual capital; viz., the resource of knowledge and the process of knowing (Nahapiet and Ghoshal 1998). These can be explained by the resource focus of the resource-based view (Barney 1991; Wernerfelt 1984) and process focus of the knowledge-based view (Grant 1996).

Resource Based View (RBV) argues that all resources that are simultaneously valuable (unique to a firm), rare (not readily bought or sold in the market), imperfectly imitable (costly or impossible to imitate) and non-substitutable (strategically equivalent substitute is unavailable) are strategic assets and a source of strength that firms can use to formulate and implement their strategies. Building on the same notion of RBV, KBV focuses on the role of knowledge; as a resource, as an asset and a capability with unique abilities to create and exploit knowledge to enhance organizational innovations, outcomes and sustained competitive advantage

(Grant 1996; Hult *et al.* 2006). Grant (1996, p. 109) argued that "coordination mechanisms through which firms integrate the specialist knowledge of their members" is the basis of a firm's capability and innovation.

Based on RBV and KBV, it is argued in this study that a firm that possesses certain knowledge assets and has the ability to exploit it in a supply chain, holds competitive advantage over other firms lacking such resources. Knowledge assets developed by using internal business processes may contain all the resource attributes. For example, based on the historical experience and employees tacit knowledge on managing inter-firm contracts, investment and trusting relationships, if a company develops a knowledge base or system customizing their business processes and inter-organizational transactions, the result is a valuable resource because the knowledge is not readily available to other firms, not quickly imitable and substitutable, and may boost the supply chain efficiency and outcome compared to other competitors. The nature of agribusiness supply chain implies that knowledge is derived from learning from past experiences such as contracts, investments and trust. If a company implements a knowledge management technique or structure to encourage and support the exploitation of existing knowledge and the creation of new knowledge from their past experience in the supply chain, it would certainly be of sustained competitive advantage.

In the agri-food industry, the flow of supply chain knowledge can be upstream from retailers towards producers, or downstream from producers toward retailers. The upstream flow may comprise information ranging from order details to the sharing of customers' requirements and strategic information, while the downstream flows may comprise product details, product origin and destination, shipment details and invoicing information (Sahin and Robinson 2002).

In Table 2.7, the sources of knowledge are categorised in seven functional links in the supply chain process related to the agri-food industry.

Table 2.7 Knowledge Flows in Agri-food Supply Chain Process

Supply Chain Process	Formally Structured	Informally Structured
Product Design and development	▪ Customer requirements ▪ Component Specification ▪ Engineering specification ▪ Estimated Cost	▪ Market ▪ Target for quality and Cost ▪ Innovative Concept
Relationship Management	▪ Information on Potential buyers sellers ▪ Corporate and marketing strategy/guidelines for Alliances ▪ Product and service agreement/contract ▪ Performance specification	▪ Market Power ▪ Expected service Level ▪ Trust
Demand and sales	▪ Purchasing information/Order receipt ▪ Sales Proposal ▪ Point of sale/key customer data ▪ Response and cycle time ▪ Order Fulfillment rate	▪ Sources of demand variability/uncertainty ▪ Bid Process
Product Processing	▪ Production Plan ▪ Schedule ▪ Capacity ▪ Inventory level ▪ Quality Plan	▪ Efficient Consumer response/Flexible manufacturing ▪ Demand forecast ▪ Technical/ Special skill
Distribution	▪ Shipment plan ▪ Delivery Plan ▪ Invoicing	▪ Logistic Process
Service and Support	▪ Customer Complaint/feedback ▪ Technical document	▪ After sale service ▪ Support for product consumption
Returns	▪ Return business rules ▪ Legal and environmental compliance guidelines ▪ Return rates and business impact	▪ Effective return process ▪ Identify defective product/areas of improvement

Partly adopted from Lin *et al*. (2002)

In the table, the knowledge flows are divided into formally structured and informally structured knowledge, where the former is usually explicit and can be codified to transmit by technologies such as EDI, Internet, Content Management System (CMS) etc., while the latter is tacit and context specific and usually difficult to formalize as it is embedded in processes or in the heads of people. Informally structured knowledge can be transmitted also by using email, bulletin boards, video conferencing etc. An efficient method of applying and utilizing knowledge in the supply chain processes will provide sustained competitive advantage; for example, in food product design and development processes a firm's performance depends on gathering knowledge on customer requirements and or market trends from its supply chain partners (wholesalers/retailers/final customers), and designing the product based on a targeted quality and cost. The phenomenon is known as 'Industrialization of Agriculture (IA)' where the decision is made at the very beginning of a supply chain based on downstream knowledge of customers and their attributes (Soucie 1997). Similarly, demand and sales management processes must balance the buyer-seller requirements and capabilities. If a supply chain uses knowledge by analyzing key customers and sales data, it helps in understanding demand variability that may assist in reducing the so-called 'Bullwhip' or 'Whiplash' effect; the phenomenon of demand distortion from lack of information by members of the supply chain attempting to achieve local optimization (Lee and Padmanabhan 1997).

However, despite a lot of research in the areas of knowledge management, there is a paucity of empirical evidence in the agri-food research domain, specifically in the context of Australia. Most past studies focused on the application of knowledge management systems in building a dynamic supply chain or a particular function of supply management. For example, Chow, Choy and Lee (2007) examined the impact of technologies adopted in build-to-order supply chains and indicated that knowledge management applications should focus on a single knowledge problem for enabling individual SC members to attain operational excellence. Wadhwa and Saxena (2007) studied how knowledge management can be used as an effective approach to achieve knowledge sharing and decision synchronisation in supply chains and provided a demo model of decision knowledge sharing for improved supply chain management. Hult, Ketchen and Slater (2004), based on knowledge-based view and theory of information processing, devised a model of strategic supply chain and showed the knowledge development process linked to the cycle time performance of 58 strategic supply chains. Horne, Frayret and Poulin (2005) provided a model of a knowledge value chain to outline the activities of knowledge creation and dissemination in the forest products industry.

Nevertheless, the current study was developed to examine the holistic effect of knowledge management in agri-food supply chain performance and, therefore, was unique in filling an existing gap in the literature. Based on the study of Hult, Ketchen and Slater (2004) and Hult *et al.* (2006), this study has investigated the effects of five major knowledge elements in the performance of a supply chain by deconstructing the larger concept of knowledge management in the context of the agri-food industry. The knowledge elements can facilitate firm-level uses and application of knowledge as a resource (knowledge asset) and increase capabilities in different facets of the food supply chain. The elements are knowledge creation and learning, memory, accessibility, shared meaning and knowledge use. Knowledge creation and learning refers to the ability by means of data mining or case-based reasoning of building usable knowledge from existing data sources, employees' expertise and learning of past experiences (Grant 1996; Wigg 1993). Knowledge memory is the acquired and stored level of knowledge in repositories, databases or electronic bulletin boards and familiarity of experience with supply chain operations (Ackerman 1994; Hult et al 2006). Knowledge accessibility is the ease of retrieving, accessing and transferring knowledge in the supply chain (O'Reilly 1982; Hult *et al.* 2006). Shared meaning is the distribution and shared understanding of available SC information. Knowledge use refers to the direct application of knowledge in solving a particular problem or making decisions related to a supply chain process (Deshpande´ and Zaltman 1982).

2.5.3 Use of Inter-Organizational Systems (IOS)

IOS is a concept that spans from EDI (Electronic Data Interchange) to electronic markets and business system networks incorporating multiple interrelated organizations (Meier and Spargue, 1991). It is an 'automated information system' shared by two or more companies or an application system that links various partners in the supply chain using computer and telecommunication technologies such as EDI, Internet, Websites, E-commerce, Barcoding, Radio tracking, etc (Cash and Konsynski 1985; Johnston and Vitale 1988; Premkumar 2000). Therefore, the electronic linking can enhance electronic flows of information across the members of supply chain and can enhance supply chain performance.

Researchers have argued that in order to gain efficiencies, companies need to exchange large amounts of planning and operational data ranging from information on annual contracts, product planning and volume of production, and the delivery and invoicing data (Saeed, Malhotra and Grover 2005, p. 369). Hence, IOS that support supply and demand integration of members along a supply chain can create competitive advantage and benefit for a firm (Porter and Miller 1985; Benjamin *et al.* 1990; Chatfield and Yetton 2000; Subramani 2004) and can influence supply chain performance (Radhakrishnan 2005; Sahin and Robinson 2002; Saeed *et al.* 2005). Despite such positive claims, other IOS empirical studies show that IOS, especially EDI, does not create a differential benefit to firms (Venkatraman and Zaheer 1995; Powell and Dent-Micallef 1997). However, by referring to the studies of Porter and

Millar (1985), Saeed *et al.* (2005) and Holland and Lockett (1997), the current research takes the view that IOS is vital in enabling a collaborative relationship structures to develop in a supply chain for competitive advantage.

Transaction cost economics (TCE) has been the dominant theoretical lens in evaluating the impact of IOS by asserting that information technology enhances interorganizational linkage and reduces coordination cost and transaction risks in supply chain relationships (Saeed, Malhotra and Grover, 2005; Clemons *et al.*, 1993). Coordination costs, one of the variables of TCE, include the cost of exchanging information on product, demand etc. and are an important source of transaction cost (Premkumar 2000). The costs again can be increased or decreased depending on the level of information asymmetry (transaction under incomplete/imperfect information), opportunism (e.g., hiding true information for transaction specific benefit) and the volume or frequency of transactions between partners (Williamson 1979). Hill and Scudder (2002) argued that the use of IOS can "facilitate frequent and automatic bi-directional information flows between supply chain partners, thus enhance degree of coordination between them" (quoted in Saeed, Malhotra and Grover, 2005, p. 369). Researchers also have used the framework of RBV to assert the contribution of IOS as an infrastructure and strategic resource that can provide greater scope for organizations to exploit their individual capabilities (Borman 2006; Schlueter-Langdon and Shaw 2002) such as managing knowledge assets and the structure of the inter-firm relationship. For example, the existing electronic trading system in the Australian agribusiness sector can allow a firm to compare the prices of alternative markets and determine supply or sourcing strategies.

Therefore, based on the above arguments, the theoretical frameworks and the existing lack of empirical evidence of IOS impact on the agri-food supply chain, the current study endeavoured to explore how the different levels/dimensions of IOS use impact on managing inter-firm relationship, knowledge asset and performance in the Australian agri-food supply chain. The study adapted four dimensions of IOS use proposed by Massetti and Zmud (1996) and Saeed, Malhotra and Grover (2005) to examine how firms initiated current technologies of IOS in the supply chain and how their use impacted on supply chain performance. The dimensions are: frequency (the number of documents and transactions completed through IOS), depth (the degree of interpenetration of partners' business processes through IOS), diversity (the number of distinct documents and transaction completed), and breadth, e.g., the degree to which the firm uses electronic links with SC partners such as one to many or many to many.

2.5.4 External Forces in Supply Chain

Jeeva (2004) identified six primary forces of environmental influence in a supply chain based on the context of Australian manufacturer; they are consumer demands, globalization, competition, information and communication, government regulation and environment (Davis 1993; Daniels 1999; Gattorna 1998). As the present study focuses on the agri-food industries, it will use three external factors; viz., technological policy (Grover 1993; Dewar and Dutton, 1986; Ettlie 1983), demand uncertainty (Grover and Saeed 2007; Petrovic *et al.* 1998), and competitors (Daft *et al.* 1988; Priem *et al.* 2002) to explore their impact on knowledge asset development, IOS use and supply chain performance (Islam and Johnson 2003; O'Keeffe 1998; Storer 2007; Champion and Fearne 2001).

Aggressiveness of a firm's technological policy mostly determines the firm's comparative ability to surpass that of other firms (Ettlie 1983). The importance of information searches in order to build the organization's knowledge base, as well as the importance of information systems to acquire, store and utilize knowledge requires that a firm should adopt a technological policy to gain competitive advantage. Studies of technological innovation posited a strong relationship between organizational knowledge and innovation (Grover 1993). In the current study it is assumed that this argument will hold true in a supply chain, so that supply chain performance is likely to realize a positive influence from the aggressive technology policy.

Demand is a multi-dimensional phenomenon generated by different market characteristics such as heterogeneity and numbers of customers, frequency of orders, variety of products and so on (Jeeva 2004); though there is a lack of methods to handle uncertainty when demand is sporadic (Bartezzaghi *et al.* 1999). Uncertainty of demand contributes to a lack of ability in completely specifying all contingencies. Thus the higher the unpredictability of demand and multitude of transactions in a supply chain, the greater the importance of knowledge development and an inter-organizational system for coordinating the mechanism of demand variability. If a firm has a sound knowledge based on past experiences of demand, and if there is an IOS to coordinate the customers' requirements, they should be a fundamental source of competitive advantage to forecast demand. Galbraith (1977) argues that high uncertainty increases information processing requirements that have to be matched by either information processing capacity or increasing slack by reducing the need to process information. Therefore, the current study proposes that demand uncertainty will influence knowledge asset development and utilization as well as IOS use in the supply chain.

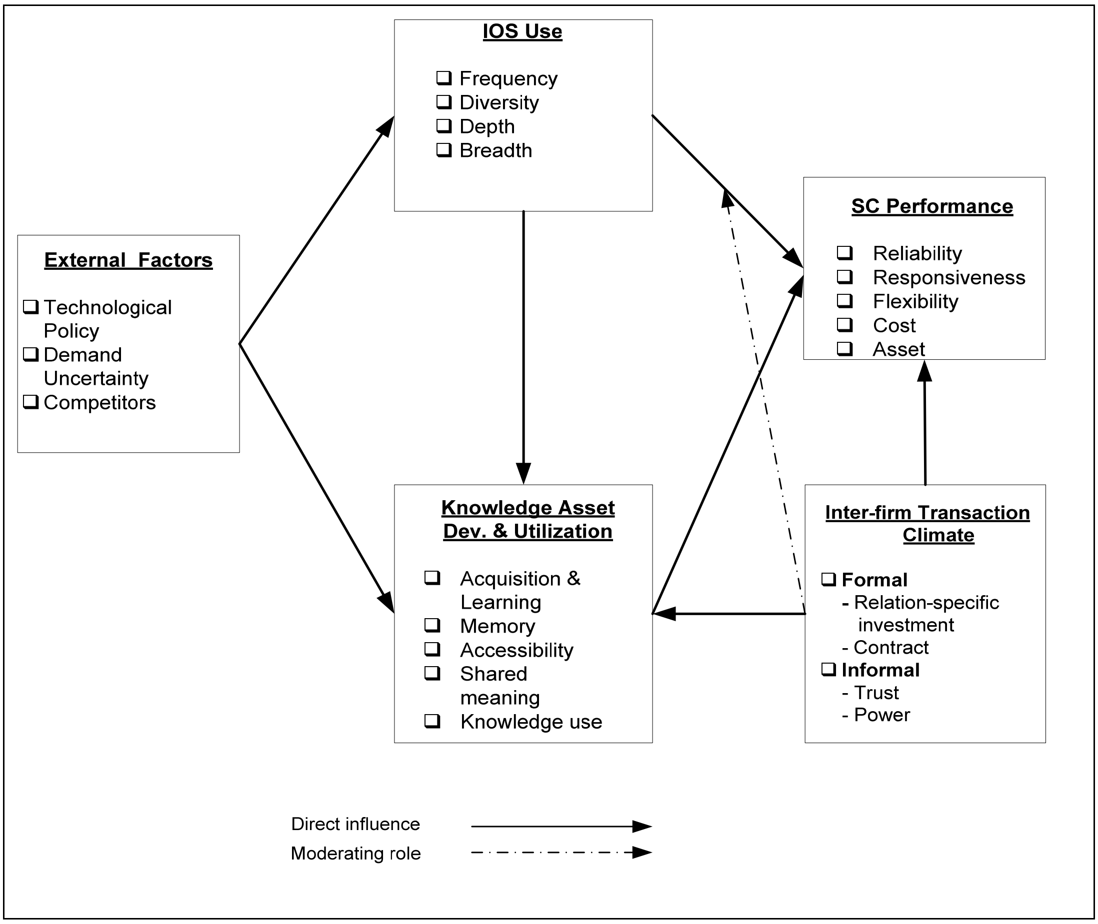
The presence of industry competitors contributes to supply chain innovation. Porter (1990) argues that related and supporting industries that are internally competitive are a determinant of competitive advantage. Traditionally, studies support the view that competitors have a significant role in determining strategic goals in manufacturing industries (e.g., Bourgeois 1985; Buchko 1994; Porter 1990). Increased globalization and advancement in technology are enablers of competition particularly driven by large multinational food manufacturers and supermarket chains; they have the ability to source their input requirements from many different countries, and put greater pressure for change on both Australia's domestic and export oriented food sectors. Therefore, in this study it is expected that a supply chain that faces strong competition but is adept at developing competitive assets by utilizing knowledge and IOS, will have a significant impact on the comparative supply chain performance.

2.6 Conclusion and Preliminary Research Model

In this chapter a comprehensive review of the literature in agri-food industry supply chain has been developed to support the background of the study and develop a preliminary model for the research. The review focused discussion on three theoretical frameworks, RBV, KBV and TCE, and provided a basis from the literature that the principles of the theories can be used to identify factors that are strategic and influence the performance of an Australian agri-food industry supply chain. It is expected that the conceptual model developed from this review will provide the context of a field study and will be refined and finalized based on the findings of the field study for a national survey to be discussed in Chapter 4.

The proposed theoretical model, as shown in Figure 2.4 is developed by combining the notions of resource-based view (RBV), knowledge-based view (KBV) and the transaction cost economic (TCE) and is supported by various authors to align the best principles of value creating strategy in firms for competitive advantage in a supply chain (Lin *et al*. 2002; Subramani 2004; Ketchen and Hult 2007).

Figure 2.4 Proposed Preliminary Model for the Research



In the preceding sections, the researcher detailed the theoretical lens, research gaps and different elements of the proposed model which are drawn uniquely to investigate three main factors, namely; ‘Knowledge Asset Management’, ‘Inter-organizational System Use' and 'Inter-Firm Transaction Climate' in relation to their influence in a supply chain's performance. Drawing on the wide research gap in the context of agri-food industry supply chains, the main theme in this study is that if a firm focuses on developing its own knowledge asset as a resource and capability, applies it to develop long-term inter-firm relationships and uses a form of IOS for integrating transactions, the combined flow of knowledge and competent transactional relationships will influence supply chain performance and, hence, firm performance. In addition, the study will examine the impacts of IOS and inter-firm relationships climate in developing knowledge asset in the Australia agri-food industry.

The concept of 'transaction climate' from Reve and Stern (1976) is applied to investigate both the structural/economic as well as behavioural climate of SC transactional relationships. Building with the cost minimization issues of transaction cost economics, the model proposes investigation of a unique set of formal and informal transaction relationships in building the strength of inter-firm relationships and their combined effect on SC performance, which have been investigated separately in the past studies (e.g., Nidumolu 1995**;** Fritz *et al*. 2007). Investigation is proposed for the moderating role of transaction climate in IOS use, which has not been explored before.

The research model also suggests examination of some external factors – 'Technological Policy', 'Demand Uncertainty', and 'Competitors', as the literature review found that these factors have an environmental influence in the Australian agribusiness sector (Islam and Johnson 2003; Jeeva 2004**).** Therefore, they will be investigated further to evaluate the impact on knowledge asset development and inter-organizational systems in the agri-food industry. Thus, the model will make a significant contribution in examining different issues of performance in the Australian agri-food industries at strategic level.

Chapter 3

Research Methodology and Design

3.1 Introduction

This chapter has detailed the research processes and methods used to explore the research questions and address the objectives that were raised in Chapter 1. Using a pragmatist research paradigm, the study followed a mixed method research design to cover a two stage research process; viz., i) a qualitative field study to enhance the theoretical model and develop a survey instrument, and ii) a quantitative study to test the research hypotheses. In this chapter the paradigm of the mixed methodology approach is first described, and then the method of conducting the qualitative and quantitative stages of the research is outlined.

3.2 Research Paradigm and Method

The research paradigm (Lincoln and Guba 2000) or worldview (Creswell 2009) can be defined as a basic set of beliefs or philosophical ideas that guide or influence the researcher's works, actions, and arguments (Guba 1990). The necessity to choose a specific paradigm was on the basis that "although philosophical ideas remain largely hidden in research, they still influence the research and need to be identified" (Creswell, 2009, p. 5). The paradigms can be visualized broadly as research methodologies (Neuman 2000) and to establish the methodological basis of the study, three major research paradigms, positivism, constructivism and pragmatism, were explored. Under certain assumptions, paradigms are also known as ontological (Guba and Lincoln 1994), epistemological (Burrell and Morgan 1979), and axiological (Hussey and Hussey 1997). Table 3.1 presents a summarized view of the research paradigms as discussed by the above authors.

Table 3.1 Research Paradigms

		Paradigms		
Assumptions	**Question**	**Positivism**	**Constructivism**	**Pragmatism**
Ontological	What is the nature of reality?	Naïve realism; reality is objective and singular, apart from the researcher.	Relativism; multiple local and specific 'constructed' realities.	Accept external reality; choose explanations that best produce desired outcomes.
Epistemological	What is the relationship of the researcher to the researched?	Objective point of view; researcher and the one being researched are independent	Subjective point of view researcher and the one being researched are inseparable	Both objective and subjective points of view
Methodological	What is the process of research?	Deductive process; quantitative: experiments, surveys, hypothesis testing	Inductive process; qualitative: In-depth interviews, focus groups, participant observation	Both inductive and deductive; both quantitative and qualitative (mixed method)

Source: Adapted from Nelson (2006).

The positivist paradigm is the experimental or empirical paradigm of research that involves deductive logic/discrete ideas used to test, observe and measure the real world objectives through precise and rigorous quantitative methods such as surveys and statistics (Creswell 2009; Neuman 2000). On the other hand, the constructivist paradigm, also known as interpretivist (Neuman 2000), is typically an approach to qualitative research by means of in-depth interviews, focus groups and participant observation from which the researchers develop subjective meanings of their experiences, use inductive logic and interpret the findings based on the broad complexity of the context (Creswell 2009; Guba and Lincoln 1994). The third approach, pragmatism, supports the use of both qualitative and quantitative research methods based on the ground that the research questions or problems are more important than either the method used or the paradigm that underlies the method. Teddlie and Tashakkori (2003, p. 21) refer this as the "dictatorship of the research question". Pragmatist researchers are free to choose all the available methods and techniques to collect, analyze and interpret the data to meet the research objectives (Morgan 2007; Patton 1990; Teddlie and Tashakkori 2003). Thus, the approach is applicable to mixed methods research where inquiries can be drawn liberally from both quantitative and qualitative assumptions (Creswell 2009).

As noted in Table 3.1, the research paradigms are linked to a number of diverse research techniques or assumptions. Ontological assumptions are related to the philosophical belief of the researcher about the nature of reality to be investigated in the study; for example, a positivist views reality as objective, external and independent of the researcher (Guba and Lincoln 1994). On the other hand, epistemological assumptions refer to the grounds of knowledge and understanding that can be acquired through different types of inquiry in the research (Hirschheim *et al.* 1995), while the methodological assumption is related to qualitative or quantitative techniques to discover the reality based on the adopted paradigm (Guba and Lincoln 1994).

To adopt a paradigm and method for this study, it was imperative to focus on the research questions and objectives. The research questions and the first three objectives of the research required defining some of the antecedent factors (such as KAM, IOS and transactional relationships) that may influence performance in the Australian agri-food industry supply chain. The research requires the developing of a supply chain performance model linking the associated antecedents and consequences in the agri-food industry. The model was developed and enhanced by combining the background literature and the real world opinions of the stakeholders working in the Australian agri-food industry supply chain. Finally, the objectives of the study required that the model must be tested to determine the important predictors of supply chain performance in the agri-food industry. Therefore, the method for the research is much like the sequential exploratory strategy, one of the mixed method strategies suggested by Creswell (2009 p. 211), that involves a qualitative leading to quantitative approach to fulfil the research objectives.

As described by Creswell (2009, p. 211), sequential exploratory strategy is a mixed method approach that “involves a first phase of qualitative data collection and analysis, followed by a second phase of quantitative data collection and analysis that builds on the results of the first qualitative phase”. The primary focus of the approach, initially, is to explore a complex research area and the phenomenon by the use of a qualitative study, and then design the survey questionnaire combining the elements of background theory and the elements that emerged from the qualitative analysis. The approach can be conducted in three phases (Creswell 2009): gathering qualitative data and analyzing it (phase 1), using the analysis to develop the survey instruments (phase 2) and then administering the instruments to a sample of population for quantitative data collection and analysis (phase 3).

Teddlie and Tashakkori (2003, p.15) argued that "the major advantage of mixed methods research is that it enables the researcher to simultaneously answer confirmatory and exploratory questions, and therefore verify and generate theory in the same study". Creswell (2009) also noted that through the exploratory phase, the mixed method can help to develop the survey instruments when existing instruments are not adequate.

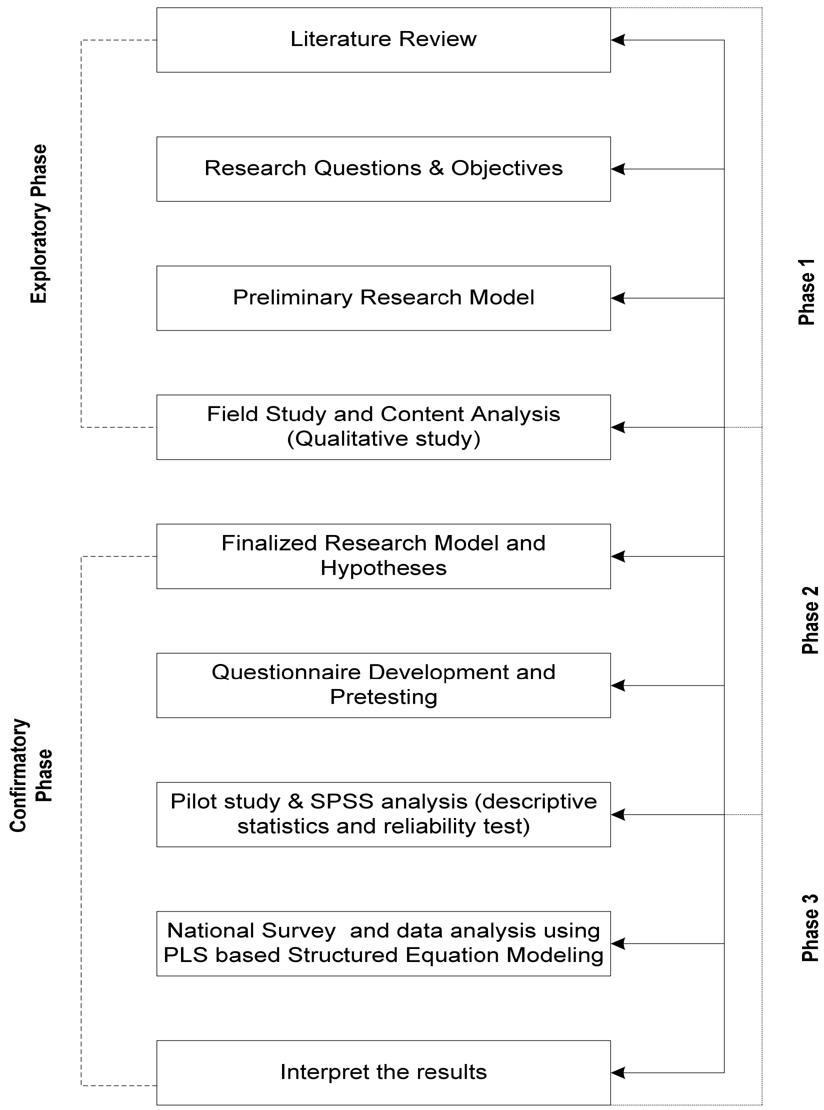
As discussed in the previous chapter, there is a lack of relevant empirical studies and appropriate scales to measure the impact of knowledge asset management (KAM), inter-organizational system (IOS) use and transactional relationship issues in the Australian agri-food supply chain. Therefore, the mixed method approach in this research can help in two ways – (i) the qualitative phase can answer exploratory questions about how and what variable/elements of KAM, IOS and transaction relationship are related to the supply chain performance, which is important for gathering the stakeholders opinions and developing the survey instruments, and (ii) the confirmatory quantitative phase can demonstrate that a particular variable/factor has a predicted relationship with performance, which is important for theory development as well as for relevant policy implications for a sustainable performance of the industry. This approach of mixed method to the agribusiness research field is also not uncommon (for examples see Bailey *et al.* 2006; Burton 2004; Jackson *et al.* 2007).

Thus, given that the objectives of the study fit the adoption of a mixed method approach (both qualitative and quantitative), the pragmatist paradigm was determined as the most appropriate philosophical worldview for the research. Epistemologically, the pragmatist approach can combine both subjective and objective points of view and can use both inductive and deductive logic for a better understanding of reality and explaining the findings; as is the case in this research. However, researchers have different positions on how paradigms are to be used in mixed methods research. Some researchers believe that they must be kept separate to realize the strength of each paradigmatic position (Brewer and Hunter 1989; Morse

1991). In that case, interpretivism/constructivism should be the appropriate approach for the qualitative part, while positivism should be the approach for the quantitative part. But some researchers strongly believe that a single paradigm should serve the foundation of mixed method research and have proposed that pragmatism is the best paradigm for justifying the use of mixed method research (Howe 1988; Tashakkori and Teddlie 1998). In this study, the stance on pragmatism is supported because specific decisions regarding the use of qualitative and quantitative methods depend on the research questions, which requires very practical and applied research philosophy. Pragmatist researchers Tashakkori and Teddlie (1998, p.30) suggested "study what interests and is of value to you, study it in the different ways that you deem appropriate, and utilize the results in ways that can bring about positive consequences within your value system".

Figure 3.1 shows the three distinct phases of mixed methods research in this study, which are divided into exploratory and confirmatory parts. It shows that the process of the first Phase (exploratory part) started with a literature review that leads to the development of the research questions, objectives, and a preliminary research model within a theoretical framework such as Transaction Cost theory and Resource-Based/Knowledge-Based theory. A field study based on semi-structured interviews was then conducted on eight agri-food firms to gather the stakeholders' experiences and opinions of their direct involved in the supply chain. The results of the interview analysis unearthed some of the important factors and variables related to the agri-food industry performance and were included to develop the finalized research model by revisiting and labeling the factors/variables within the literature. The results, then, lead to the Phase 2 (quantitative part) for the development of constructs and measurement scales, associated hypotheses, and developing and pre-testing the survey questionnaire. In Phase 3 (continuation of the quantitative part) a national survey was conducted and the data were analyzed using PLS-based structural equation modeling for confirmatory factor analysis and testing of hypotheses.

Figure 3.1 Mixed Methods Research Approach for this Study



3.3 The Research Process

3.3.1 Qualitative Field Study

As stated in the preceding section, a qualitative field study was used for exploring and answering the research questions in real world conditions (Mason 1990). The main purpose was to identify the factors affecting food industry performance and then use the results to enhance the preliminary research model and develop a quantitative survey. The qualitative study was based on in-depth interviews with stakeholders of the agri-food industry. In-depth interviews are useful when a focus on contemporary events or a natural setting is required to understand and describe a particular context, or test a theory (Carson *et al.* 2001), although the objective was not to draw inferences about some larger population but rather to generalize back to a theory or application (Chan and Ngai 2007; Yin 2003).

3.3.1.1 Sample

The sample in the study was comprised of key participants in agri-food supply chains ranging from upstream growers/producers to downstream processors, wholesalers and retailers. The participants were divided into three main groups – (i) Farmers, (ii) Processors and (iii) Retailers/Wholesalers. A convenience sample was drawn to select participant firms based on their willingness to participate in the study (Zikmund 2003; Xu and Quaddus 2005). The sampling technique was also designed to cover all the three groups of firms in the agri-food supply chain. The main criterion for selecting the sample firms in the case of farmers/producers was the involvement in supply chain transaction; while for the processors and retailers it was the size of the business. In addition, interviewees were selected based on their key role in supply chain/distribution or the logistics side of the company. Thus, eight interviews were recorded for the study as literature suggested a selection of 8-10 sample cases is typical in a qualitative study (Chan and Ngai 2007; Eisenhardt 1989). The interviewed firms were selected from a discussion event organized by DAFWA (Dept of Agriculture and Food, WA) and a sponsor of the research, where the researcher had given a presentation of the work on agri-food companies, while, other firms were selected through a series of personal contacts over phone and email with a detailed explanation of the research objectives.

3.3.1.2 Data collection

The main objective in the qualitative phase was to investigate and characterize the use and impact of current knowledge management, inter-organizational systems and methods of transaction relationship on the agri-food industry supply chain. Based on the objective, all data were collected through the technique of in-depth interviews following the guidelines of McGivern (2003), Carson *et al.* (2001) and Whiteley (2004). They argued that the structure of qualitative research interviews should have three phases: planning, starting and managing the interviews. McGivern (2003) stressed that an interview should start with a clear introduction and 'warm up', then the main body, and be followed by a clear signal of ending or ‘wind down’. These suggested guidelines were followed to develop the interview structure and finally conduct the actual interviews where the researcher always started with an informal but research relevant introduction with the interviewees about their role and business importance in the company. The interview schedule was arranged based on interviewee convenience, availability and voluntary willingness. Based on the preliminary conceptual model and study objectives, a set of interview questions were developed from the literature review for a semi-structured interview. It helped to maintain the focus on relevant topics such as supply chain governance and performance factors, existing relationships, transaction climate and the impact and use of knowledge assets and inter-organizational systems in the supply chain. The questions were pretested with a participant firm from the meat industry to ensure the relevancy, timeliness, and accuracy of the data collection instrument. Details of the qualitative data collection processes are given in Chapter 4.

3.3.1.3 Data analysis

Although only eight interviews were conducted, the transcription of the recorded interviews resulted in 88 pages of script to analyze. As the research at this stage was exploratory, the data were analyzed using a content analysis procedure. NVivo 8.0 software (a qualitative data analysis software package) was used for the analysis and for the identification and categorization of important factors, variables and their links to supply chain performance. The analysis was initiated by scanning transcripts one by one to develop core issues and sub-themes. The themes and sub-themes developed from the analysis of one interview transcript guided the analysis of other interviews, while all the emerging concepts were included, revised and categorized by checking across the interviews and visiting, revisiting and labeling in accordance with past literature. Finally, the results were reported summarizing the findings in an ‘across case contrasts’ matrix (Miles and Huberman 1984) with visual presentation of the factors, sub-factors and associated variables in figures and tables.

3.3.2 Empirical Pilot Study

The main objective of this phase was to develop the survey by minimizing the occurrences of errors in the survey instruments (details are provided in Chapter 6, Section 6.3). Along with the different methods of pre-testing the survey instruments, a mini-version of the full scale survey was conducted using the following steps:

3.3.2.1 Developing the questionnaire

A questionnaire was developed based on the final research model, its constructs and sub-constructs. The final research model is described in Chapter 5 and the questionnaire development and pretesting process is discussed in Chapter 6. Most measurement items of the constructs and sub-constructs in the study were adopted from previous scales in past studies, while some were developed from scratch, based on the findings of the qualitative field study. All the questions, except those related to the demographic data, used a Likert-style seven-point scale ranging from strongly disagree to strongly agree or never to always.

Expert review is one of the popular front-end methods of pretesting a questionnaire (ABS 2001; Presser and Blair 2004). The newly developed questionnaire and its measurement scale used in this study were reviewed by three professional experts to identify potential errors in comprehension, logical structure and relevancy or redundancy in the questions. After completing and adopting the suggestions from experts, a total of ten cognitive interviews[2] were conducted with the previously known producer, processor and retailer firms. The main purpose was to get feedback as to whether or not they had understood the questions, wording and relevant terminologies in a consistent way.

A pilot study was used, then, as the final step of evaluating the questionnaire and the associated instruments.

[2] Ordinary interviews focus on producing codable responses to the questions but cognitive interviews, by contrast, are directed at understanding the thought processes the respondent involves in interpreting and answering a question (ABS 2001; Ericsson and Simon 1993).

3.3.2.2 Sample selection and data collection

The pilot study was conducted among supply chain participants (input suppliers, producers, processors, wholesalers and retailers) of the beef industry in two states of Australia - WA and Queensland. Instead of focusing on the overall agri-food supply chain, at this stage the beef industry, as a particular agri-food industry, was chosen for the pilot study and for the final survey. The decision was made based on the experience of the field study; it was considered that the contribution from this study can be more practical and useful for Australia if a specific industry supply chain was chosen. The beef industry was selected because, although it is the largest agri-food industry in Australia in value, its productivity and performance is declining in the long-terms (MLA 2008). The trial data collection was conducted using a telephone survey method (Dawes 2001) by contracting a professional survey research centre from Edith Cowan University, Western Australia. A total of 68 telephone responses were collected covering all categories of supply chain participants within a time line of two weeks.

The trial also covered observation and behavior coding (systematic coding of the interactions between an interviewer and a respondent) over the telephone interviewing process and examined the length, flow and acceptability of the interviews and the instrument's rating scale to the respondents.

3.3.2.3 Data analysis

The collected data were examined to see whether there were any inconsistencies and obvious errors. Descriptive statistics were used for this purpose and some minor problems were addressed at this stage. Then, an SPSS reliability test was used to check the Cronbach alpha of internal consistency of the set of items. It was the first and most common measure to assess the quality of the survey instruments (Churchill 1979; Nidumolu 1995) and helped in gaining insight of important factors and the homogeneity and consistency of the rating scales. Considering the exploratory nature and the early stage of research, all alpha levels were found to be acceptable. Finally, based on the interview observation about the interviewee and interviewer interactions, interview flow and length, and the response and rating scale of the questions, some minor changes are made.

3.3.3 National Survey

3.3.3.1 Sample selection

The final survey was carried out on the beef industry, the most important sector of Australian agri-food industry, to apply the research model and test the hypotheses in a confirmatory phase and identify the important predictors/factors of supply chain performance. As discussed in detail in Chapter 5, the beef industry was chosen based on its relative importance to the agri-food industry and on the ground that the outcomes would be more useful in achieving a particular supply chain perspective. Given the available funds, targeted respondents and objectives of the research, the nation-wide survey covered the states of Western Australia and Queensland. The motivation to select WA and QLD among the other states of Australia was that the selected states could be used to represent the beef industry of other states and generalize the results to the overall Australian beef industry. While the main focus of this study was on WA, much of the national industry information was linked to QLD among the other states and territory of Australia. In terms of beef production and export, the WA beef industry is comparable to that in South Australia and Tasmania; while QLD is comparable to the beef industry in New South Wales and Victoria (WY and Associates 2009). QLD has the nation's highest beef cattle herd and largest export market while WA also ranked fourth in beef production and export.

Targeting one response per firm with the person holding a higher position in the supply chain/distribution, a list of around three thousand company addresses and phone numbers from WA and QLD was generated through the help and use of government and private organization databases such as the Department of Agriculture and Food in WA and AGFORCE Queensland. Sample respondents were categorized as beef-cattle producers, processors, exporters, retailers, wholesalers and input suppliers. Using the method of stratified random sampling, a quota system was then applied to carry out the survey; viz., a minimum of 30 and a maximum of 100 responses were targeted for a proportionate distribution of the respondents in each of the two states according to the three main categories – producers, processors/exporters and retailers/wholesalers. The final sample included all the available beef processors, beef producers having more than 100 head of cattle and a large number of retailers and input suppliers.

3.3.3.2 Data collection through telephone survey

Increasingly, researchers have been inclined to implement different data collection strategies such as sending advance letters, offering incentives and increasing number of call attempts in telephone surveys to combat the low response rate and data quality (Hollbrook, Krosnick and Pfent 2008; Curtin, Presser and Singer 2005; Tortora 2004). Survey strategies also depend on the types of respondents, amount of effort to be made to contact the respondent, and the available time and geographical coverage (Hallbrook *et al*. 2008). The wide geographical distance between the sample States made it difficult to use face-to-face interviews, while a mail survey was ruled out because of the increased report of a lower response rate in Australia especially, when the respondents are in the top-level management of a firm (Jackson 2008) Therefore, it was decided to use the telephone survey method by using a computer-assisted telephone interviewing (CATI) system (Zikmund *et al.* 2007; Niemann 2003). Using a computerised questionnaire and trained interviewers, a telephone survey can collect complete and accurate data that can be comparable to the quality of data collected in personal interviews but with more efficient use of time and resources (Robson 2002; Zikmund *et al*. 2007)

Based on the telephone survey, the data were collected by contracting the professional survey research centre at Edith Cowan University Perth, Western Australia. The survey centre used the CATI system, which is operated from a centralized telephone laboratory equipped with a server, CATI software, a supervisor workstation and several interviewer stations; all connected in a local area network (LAN). The researcher supplied the survey centre with the survey questionnaire with ethics approval from Curtin University's Ethics Committee. It was then converted and designed according to the CATI system, which allows easily manageable skipping, looping and routing through the questionnaire. The survey centre trained three interviewers to conduct the interviews with specific guidelines from the researcher and the survey supervisor; such as, reading the questions from the computer screen, asking them over the phone, and keying the responses into the system. The CATI software also managed the sample records and released them randomly, administered appointments, and saved interview data. Call dialling was made randomly with the support of a predictive dialling system; call outcomes were detected automatically but answered live by an available interviewer. If the person called was not available at that time, up to three call backs were made to contact them to make an appointment.This technique prevents bias by the interviewer in respondent selection. Moreover, a proportion of the interviews were randomly monitored by a supervisor to ensure the interviewers followed their instructions closely as part of normal quality control guidelines. Finally, the survey centre statisticians edited each completed survey to check for clarity and completeness of the data before finally supplying it to the researcher.

The survey was administered during September and October 2009. A quota system was applied where a minimum of 30 and a maximum of 100 responses were targeted for each of the three main categories of respondents' firm; viz., producers, processors and retailers in WA and QLD. The CATI system made administering different versions of the questionnaire to different categories of firm (in terms of their role as a buyer or seller in a supply chain) very easy. Thus, a total of 315 valid responses from the beef industry of WA and QLD in Australia were eventually obtained.

3.3.3.3 Use of Structural Equation Modelling (SEM) for data analysis

Structural Equation modeling (SEM) "is a multivariate technique combining aspects of multiple regression (examining dependence relationship) and factor analysis (representing unmeasured concepts – factors – with multiple variables) to estimate a series of interrelated dependence relationships simultaneously" (Hair *et al.* 1998, p. 621). It is also known as a second generation methodology, confirmatory factor analysis, latent variable analysis, and/or causal modeling. It is an extension and improvement of first generation techniques such as multiple regression, multivariate analysis of variance, principal component analysis, factor analysis and/or discriminant analysis because of the greater flexibility to interplay between theory and empirical data (Bagozzi and Fornell 1982; Chin 1998b; Holmes-Smith 2001). There are some common limitations for all of the first generation statistical techniques, such as: i) they can only examine or represent a single relationship at a time; ii) the assumption that all variables can be considered as observable; and iii) the conjecture that all variable are measured without error (Barclay, Higgins and Thompson 1995; Haenlein and Kaplan 2004**)** But, as a second generation multivariate tool, SEM addresses the assumption of multiple regression and path analysis and thus can test a "series of dependence relationships simultaneously, particularly, when one dependent variable becomes an independent variable in subsequent dependence relationships" (Hair *et al.* 1998, p. 617)). Therefore, SEM has greater flexibility and was chosen for this study considering the following substantial advantages over first generation techniques (Chin 1998b; Hair *et al.* 1998; Holmes-Smith 2001); SEM can be applied to:

i) Model multiple relationships among multiple predictors and criterion variables in the form of multiple regression and path analysis. The relationships for each dependent variable are translated and tested into a series of structural equation similar to regression equations.
ii) Represent unobservable latent variables by estimating the relationships among 'latent' constructs and underlying observed variables.
iii) Examine validity, reliability and the relationships among the latent variables to confirm a theory or model. This ability of SEM has provided a transition from exploratory to confirmatory analysis.
iv) Model explicitly the measurement errors for the indicators or observed variables.
v) Estimate hierarchical multi-dimensional constructs that can measure recursive and non-recursive relationships.
vi) Test prior substantive/theoretical and measurement assumptions against empirical data.

In SEM, a latent variable (LV) or unobserved variable represents a conceptual term to express a theoretical concept or phenomenon that cannot be observed directly, while the observed variable indicates measurement items or indicators that can be measured directly. Latent variables can be exogenous and typically denoted by ξ, and endogenous denoted by η, whereas the path between the indicators and latent variable is denoted by λ to represent the item loading or weight.

The development of a research model using SEM can be divided into two parts (Hair *et al.* 1998):

1) Measurement Model which specifies the indicators for each construct and assesses the reliability of individual constructs for estimating the causal relationship, which is similar to factor analysis, and
2) Structural Model which links the model constructs based on theoretical/hypothesised relationships.

USE of PLS-SEM for this study as opposed to COV-SEM

As indicated above, SEM can be used with empirical data to test the detail of the measurement and structural part of a research model in order to accept or reject the theoretical relationships. There are two approaches to estimating the parameters of a SEM; i) Covariance-based SEM (COV_SEM) such as LISREL, EQS, AMOS or CALIS and ii) Variance or component-based SEM (PLS-SEM) such as LVPLS, PLS-GUI, SPAD-PLS, VisualPLS, PLS-Graph, and SmartPLS. They can be "viewed as a coupling of two traditions - an econometric perspective focusing on prediction, and a psychometric emphasis that models concepts as latent (unobserved) variables that are indirectly inferred from multiple observed measures" (Chin 1998b, p. 1).

The choice and application of a SEM approach depends on the specific situation, modeling of the construct with its measurement items and objective of the study such as whether it will be used for theory testing and development or for predictive applications. COV-SEM is best suited for theory testing and development; i.e., how well a theoretical model fits observed data whereas variance based SEM is primarily intended for causal-predictive analysis with a complex model to test its predictive power (Barclay, Higgins and Thompson 1995; Chin, Marcolin and Newsted 1996; Joreskog and Wold 1982). The covariance based approach "attempts to minimize the difference between the sample covariances and those predicted by the theoretical model ... therefore, the parameter estimation process attempts to reproduce the covariance matrix of the observed measures" (Chin and Newsted 1999, p.309; also quoted by Haenlein and Kaplan 2004, p. 290). Instead of reproducing the empirical covariance matrix, PLS focuses on "maximizing the variance of the dependent variables explained by the independent variables" (Haenlein and Kaplan 2004, p. 290).

COV-SEM usually provides a goodness-of-fit measure to meet the theoretical appeal of how well the hypothesized model fits the data; e.g., the likelihood ratio chi square that evaluates goodness of fit with respect to the covariance matrix of the measures. By comparison, PLS-SEM has different objectives such as allowing formative measures, and testing of hypotheses by predicting antecedent conditions on the dependent variables. Therefore, it is not able to provide such 'fit' measures but, instead explains the variance in a regression sense and provides measures like factor loading, R^2, and the significance of relationships among constructs that can be more indicative of how well a model is performing. Researchers have argued that a good covariance fit does not support any conclusion compared to R^2 and factor loading, as the covariance fit only relates to how well the parameter estimates are able to match the sample covariances not how the latent variables or item measures are predicted (Chin 1998a , Fornell and Bookstein 1982). The algorithm in covariance-based SEM "takes the specified model as true and attempts to find the best fitting parameter estimates ... thus model with Low R^2 and/or low factor loading can still yield excellent goodness of fit" (Chin 1998b, p. 6).

The use of formative measures in covariance-based SEM becomes problematic as it attempts to account for all the covariances among the measures because of the statistical algorithm that assumes the correlations among indicators for a particular latent variable are caused by that latent variable; therefore all items in covariance-based SEM must be modeled as reflective (Chin 1998b; Fornell and Bookstein 1982). Attempts to create a model with formative indicators may lead to an 'identification problem' (Jarvis *et al.* 2003) and can produce invalid estimations even though the presence of a reasonable goodness of fit (Chin 1998a).

PLS-SEM can avoid the problems of analyzing formative indicators because, instead of factor analysis or covariance structure analysis, it provides a general model similar to the class of principal components, canonical correlation and regression analysis. The PLS model is based on Non-linear Iterative Partial Least Squares (NIPALS), introduced by Wold (1975), where the "the conceptual core of PLS is an iterative combination of principal component analysis relating measures to constructs, and path analysis permitting the construction of a system of constructs ... the estimation of the parameters representing the measurement and path relationship is accomplished using ordinary Least Squares (OLS)" (Barclay, Higgins and Thompson 1995; p. 290). Therefore, identification is not a problem for the formative and recursive model. PLS assumes that all the measured variance is useful to explain and estimate the latent variables as exact linear combination of the observed measures thereby avoiding the factor indeterminacy problem by giving the exact definition of a component score (Anderson and Gerbing 1988; Chin, Marcolin and Newsted 1996**).**

PLS is suited for explaining complex relationships modelled with many construct and many paths (Fornell and Bookstein 1982). Wold (1985, p.589, cited in Chin, Marcolin, and Newsted, 1996) stated: "PLS comes to the fore in larger models, when the importance shifts from individual variables and parameters to packages of variables and aggregate parameters". Another difference is that PLS can be used with a small sample, while researchers suggest a minimum sample of 200 cases for COV-SEM to avoid the misinterpretation of results (Chin 1998a; Holmes-Smith 1999), PLS is applicable even for a very small sample size.

While the major differences between COV-SEM and PLS-SEM have been presented in Table 3.2 in terms of statistical inferences, assumptions of factor structure, and interpretation of measurement error, it should be noted that they are not competitive models but should be viewed as complementary based on the purpose and nature of the study (Chin, Marcolin, and Newsted 1996). In this study PLS-SEM was chosen because of its ability to handle both formative and reflective measures, the ability to deal with a small to medium sample size and, most importantly, because of the predictive nature of the study where a large number of antecedent variables will be used to predict the relationships with some dependent variables (Chin 1998b; Chin and Gopal 1995). As the main focus of the research was to investigate the significant causal relationships associated with supply chain performance, PLS was identified as the best suited SEM technique for this causal-predictive analysis; i.e., for testing the predictive power of the performance model and then developing the theory (Anderson and Gerbing 1988; Barclay, Higgins and Thompson 1995; Chin 1998b; Santosa, Wei and Chan 2005).

Table 3.2 Difference between Covariance-Based SEM and Variance-Based SEM

COV_SEM	PLS-SEM
Covance–based Approach such as LISREL, EQS, AMOS	Variance-based Approach such as LV-PLS, PLS-PC, PLS graph, Smart-PLS
Attempts to reproduce the covariance matrix of the observed variables or measures	Aims at explaining variances of observed/unobserved variables in a regression sense
Most suitable where prior theory is strong and further testing and development is the goal	Most suitable for prediction where the research model is comparatively complex but the theory is still under development
Data should follow Multivariate Normal distribution with independent observation and thus parametric	No normality assumption is needed. Predictor specification and thus non-parametric
In treating measurement residuals , it combines specific variance and measurement error into a single estimate and adjust for attenuation	Separates out irrelevant variance from the structural portion of the model
Parameters oriented and thus offers statistical precision in the context of stringent assumptions	Prediction oriented. Trade off the parameter efficiency for prediction accuracy, simplicity, and fewer assumption
A loss of predictive accuracy can exist because of the indeterminacy of factor score estimations.	Estimates the latent variables as exact linear combinations of the observed measures, and thus avoids the indeterminacy problem and provides an exact definition of component scores.
Incorporates overall goodness of fit measures, such as a likelihood ratio chi square to see how well the hypothesized model fits the data	Factor loading, $R^{2,}$ and the significance of relationships among constructs are measures to indicate how well a model is performing
Requires relatively large samples (200 to 800) for accurate estimation but relatively few variables (100 indicators) and constructs for convergence	Applicable to small samples (30 -100 cases) in estimation as well as testing. Appears to converge quickly for large models with many variables and constructs (e.g. 100 constructs and 1000 indicators
Typical application is only with reflective indicators	Can be modelled in either formative or reflective mode

Source: Adapated from Anderson and Gerbing 1988; Barclay, Higgins and Thompson 1995; Fornell and Bookstein 1982; Chin and Newsted 1999.

PLS estimation methods

The PLS-Graph version 3.0 (www.plsgraph.com) developed by Chin (2001) was used to analyze the survey data. PLS path modelling was developed mainly by Wold (1982, 1985) with the theoretical and computational aspect (LV-PLS software) developed by Lohmloller (1989) and further enhanced by Chin (1998a) in a new software with a graphical interface. *PLS-Graph* is a Windows-based program that uses modified routines of *LVPLS* and can only processes raw data (LVPLSX). The graphical interface and tools are available to specify the model and different options such as a weighting scheme and re-sampling method can be chosen from the menu.

PLS has been applied very extensively in information systems, management and marketing studies in the past (see Quaddus and Hofmeyer 2007; Jackson *et al.* 2007; Rai *et al*. 2006; Santosa, Wei and Chan 2005; Venkatesh *et al. 2008*; Johnston *et al.* 2004). Like any SEM, a PLS model also consists of two parts; a measurement component to show how the observed variables or the indicators are related with the latent variables, and the structural part that shows the theoretical relationships between the latent variables. Therefore, the data analysis stages in PLS also can be divided into two parts**:**

i. Assessment of the measurement model, i.e., the outer model that shows the relationship of a construct and its measurement items that assess: i) the reliability of individual item/manifest indicators that make up the measure of a construct; ii) the composite reliability or internal consistency of the item as a group (comparable to Cronbach's α); and iii) the discriminant validity which is the average variance extracted (AVE) from the constructs by each of the items (Barclay, Higgins and Thompson 1995; Fornell and Larcker 1981).

ii. Assessment of the structural model, i.e., the inner model that shows the hypothesized relationship between constructs by reporting the path coefficients and t-statistics between constructs.

Details of PLS techniques of assessing the measurement (outer) and structural (inner) parts of the research model are given in the data analysis section in Chapter 7.

3.4 Missing Values Treatment

Multivariate techniques always require a complete data set but it is true that most survey data contain missing values because of the refusal of the respondent to answer certain questions, interviewer inefficiency, system malfunctioning and so on (Batista and Monard 2003). Whatever the source, an acceptable remedy for the treatment of missing data must be applied, otherwise potential 'hidden bias' can impact on the sample size and precision of the result of the study (Hair *et al.* 1998). Therefore, analysing the pattern of missing data such as location of the missing values, their extent or randomness in the survey provides additional background information which the researcher can use to replace or impute the value using appropriate methods.

Most software packages offer listwise (LD)/pairwise (PD) deletion or mean imputation of missing data, but these kinds of approaches have little theoretical justification because LD may exclude a lot of useful information, while PD and mean imputation have disadvantages of computing covariances based on different sample sizes and biased parameter estimates (Allison 2002, Brown 1994; Temme, Kreis and Hildebrandt 2006; Little and Rubin 2002). In contrast, multiple imputation and direct maximization of the likelihood of observed data based on Maximum Likelihood Estimation (MLE) has been developed since 1980 as a more acceptable method of dealing with missing data in structural equation modelling (Little and Rubin 2002; Wothke and Arbuckle 1996).

Little and Rubin (2002) suggested three classes of randomness of missing data. They argued that the choice to deal with the missing values should be based on how they are generated, such as; i) missing completely at random (MCAR) – a highest level of randomness when the probability of the missing value is a constant and independent of all the values of the variables in the survey; ii) missing at random (MAR) also known as ignorable missing data happens when missing values are not randomly distributed across all observations but are randomly distributed within one or more variables or sub-samples; and finally iii) missing not at random (MNAR) or non-ignorable missing data happens when the probability of missingness depends on the value of variables that may themselves be missing (Batista and Monard 2003, Pickles 2005)

MCAR can be confirmed by dividing respondents with and without missing data and then using a t-test of mean difference. If the data are MCAR, it is safe to use any method of estimation such as LD, PD and series mean or regression estimation that will give consistent and unbiased estimates, but if data are MAR, it is better to use MLE (Maximum Likelihood Estimation) which is considered superior to other methods (Little and Schenker 1995, SPSS 2007). MLE is implemented by the EM (Expectation Maximization) algorithm in SPSS 17 with Little's MCAR test under the MVA (missing value analysis).

As a rule of thumb if there is less than 5% missing values on a particular item of a dataset, it is unlikely that those missing values are not MCAR. The MVA analysis of the survey data was conducted using SPSS 17 to explore the number of missing and non-missing values, their pattern, mean and standard deviation. It was found that some of the items such as TC3A (7.9 %, under the variable transaction climate), CF3 (7%, under SC Performance variable), CMP1 (14%) CMP4 (13%, under Competitiveness variable) have more than 5% of the missing values. The MCAR test revealed that the *p* value is significant at 0.05 levels, thus, confirming that data are not MCAR but MAR with some items missing at random and dependent on the values of other items. For example, after answering a question about how a respondent shares business risk/benefit with the buyer, the same question about how the respondent shares the risk with a supplier sometimes produced non-responses. Similarly some questions regarding performance and competitiveness in the supply chain produced more non-responses that are dependent on other observed data.

As the data are MAR, it was decided to use the Estimated Mean (EM) for the imputation of missing data because estimates other than EM could be biased (Little and Schenker 1995; SPSS 2007). The EMs also were compared with the regression mean, means of Listwise deletion and means using all non-missing values (true value). EM was found much better at predicting a mean for the missing values and was consistently closer to the true value (the mean of all non-missing values in the complete data set).

3.5 Summary

This Chapter has provided details of the research process and the philosophical and methodological approaches undertaken throughout the research. Given that research objectives suited the adoption of a mixed method approach (both qualitative and quantitative), the pragmatist paradigm was determined to be the most appropriate philosophical worldview in the research. 'Pragmatism' supports the use of both qualitative and quantitative research methods based on the ground that research questions or problems are more important than either the method used or the paradigm that underlies the method.

The mixed method approach to this research can help in two ways – the qualitative phase leads to answer the exploratory questions, while the quantitative phase demonstrates confirmatory results by factor analysis and testing of the hypotheses. Using a 'sequential exploratory strategy', the mixed method approach was conducted in three phases (Creswell 2009): i) developing a preliminary theoretical model from literature review and then conducting a qualitative field study, ii) using the qualitative analysis to develop survey instruments, followed by pretesting and a pilot survey and, finally, iii) administering the instruments to a sample of population for quantitative data collection and analysis.

Based on in-depth interviews, the qualitative field study was conducted at eight agri-food companies using convenience sampling for the inclusion of three groups of firm - producers, processors and retailers in the supply chain. Following a content analysis procedure, NVivo 8.0 software was used for analyzing the transcripts and for the identification and categorization of important factors, variables and their links to the supply chain performance.

The findings of the field study were used to enhance the preliminary research model, finalize the model and develop associated constructs and hypotheses for a quantitative survey. The survey instruments, including the questionnaire, were developed and pre-tested through a pilot survey on 68 respondents. The descriptive statistics and reliability test in SPSS did not reveal any major problems. Finally, the national survey was conducted on the beef industry in WA and Queensland to test the research hypotheses. The method of telephone survey resulted 315 valid responses, which were analyzed using the Partial Least Square (PLS) based Structural Equation Modeling technique. The method of treating missing values was also described.

Chapter 4

Qualitative Field Study and Modified Research Model*

4.1 Introduction

Studying a business system requires collection of raw data and understanding of the system context with real world conditions. Therefore, this study in the Australian agri-food industry used a mix methodology; (i) a qualitative field study to support the theoretical model and (ii) a quantitative study based on the finalized model developed through the field study (Gabe 1994; Tashakkori and Teddlie 1998). This chapter reports on the results of the qualitative field study. The purpose was to explore the particular supply chain information, concurrent ideas and experiences of the agri-food industry people within a theoretical model generated at the beginning of the research using the existing case studies, academic work and literature (discussed in Chapter 2). The instrument used to conduct the field study was developed from the existing studies to meet the convenience, consistency and acceptability of the subject involved. The data and information gathered from the field study was analyzed using the content analysis software NVivo 8 (a qualitative data analysis software package, see for details http://www.qsrinternational.com). Content analysis was used to identify the important factors and variables influencing the food industry supply chain; these factors, variables, and the knowledge gained from field study were used to modify the preliminary conceptual model. The process

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* Part of this chapter has been presented at the following conferences:

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Impact of inter-organizational relational mechanism on firm performance: Some exploratory findings in Australian agri-food industry supply chain, , in: *Proceedings of the* Oxford Business and Economics Conference (OBEC), 28-30 June, 2010, St Hugh's College, Oxford University, UK.

Uddin, M.N. 2009. Impact of inert-organizational relationship and knowledge Asset development in supply chain performance: A qualitative inquiry in Australian agri-food Industry in *Curtin Business School Doctoral Students' Colloquium 2009* – Curtin University of Technology, Perth, Western Australia.

Uddin, M.N. and Quaddus, M. 2008. A theoretical insight of knowledge asset and transaction climate in the Agri-food Industry Supply Chain: Perspective of Australia, In: *17th Annual IPSERA Conference, Perth, Australia, 9-12 March 2008.*

resulted in a more comprehensive model and associated hypotheses to conduct the broader quantitative survey - the second part of the research.

4.2 Operationalization of the Field Study

4.2.1 Qualitative Research Paradigm

As the paradigm of research is a whole framework of beliefs, values and methods, the information reported in this chapter is an outcome of the field study conducted within the qualitative paradigm using a pragmatist approach (discussed in Section 3.2). The purpose was to explore the existing practices and views of agri-food industry people in regard to the supply chain performance. As stated in Chapter 3, the qualitative field study was undertaken as the initial part of the mixed methodology for developing and complementing the preliminary conceptual model of Australian food industries. Because the researcher argued that a combination of both the qualitative and quantitative research method can better fulfill the research objective (Amaratunga *et al.* 20002; Neuman 2006), it is argued that qualitative data (e.g., in-depth interviews) may allow greater depth, and quantitative data (e.g., surveys) may give greater breadth (Tashakkori and Teddlie 1998). Moreover, in the agribusiness research domain, a combination of using qualitative and quantitative research methods is common (Jackson *et al.* 2007; Bailey *et al.* 2006; McEachern and Warnaby 2005).

4.2.2 Method of Data Collection

A field study based on in-depth interviews was adopted as the method of qualitative inquiry in the agri-food industry, as it is a dynamic, non-linear process that allows the researcher to become familiar with the research topic (Mason 1990) in real world conditions. Moreover, there is evidence from hundreds of years of using interviews as an effective tool to collect data (Whiteley 2004; Xu 2003). The advantage of in-depth interviews is that they can cover a wide area of interest, helping the researcher to explore and identify key issues (Carson *et al.* 2001). It provides up-to-date, rich and detailed information and key insights enabling the researcher to identify important factors involved in the study (Nelson 2006) though they may not be directly observed by the researcher himself (Burns 2000). However, the best utilization of the method depends on the knowledge of researchers as to the background theory, as well as their communication skills with the interviewee (Mason 1990).

Although interviews may take the form of an informal or natural conversation, the study followed a semi-structured interview technique following a 'guided conversation' (Rubin and Rubin 1995) based on some pre-set but open-ended questions to ensure that the focus stayed relevant to the topic and investigation (Burns 2000; Nelson 2006). The interviews lasted from 45 minutes to an hour as is typical in this type of research (McGivern 2003; Zikmund 2003) and discussions were recorded on a voice recorder device to check and re-check the key issues and interviewees' opinions, beliefs and experiences (Chrzanowska 2002; McGivern 2003; Morgan 1997)

4.2.3 Sample

The sampling and number of interviews in a field study may depend on the research objectives, complexities and on the available time and cost (McGivern 2003). However, in this study eight interviews were conducted; one in each of the eight agri-food firms in Australia, as a selection of 8-10 sample cases is typical in a qualitative study (Eisenhardt 1989; Chan and Ngai 2007). As the intention was to interview the key participants of supply chains ranging from upstream growers/producers to downstream processors and retailers/wholesalers, a convenience sampling was undertaken to select the participant firms based on their willingness to participate in the study (Xu and Quaddus 2005; Zikmund 2003). The targeted participants were divided into three groups of (i) farmers, (ii) processors and (iii) retailers/wholesalers where the main criterion for selecting the sample firm was its involvement in a supply chain transaction. In addition, the interviewees were selected based on their key role in the supply chain/distribution or logistics side of the company. Table 4.1 listed the role and business type of participants and firms.

Table 4.1 Demographic Information of the Participants Company

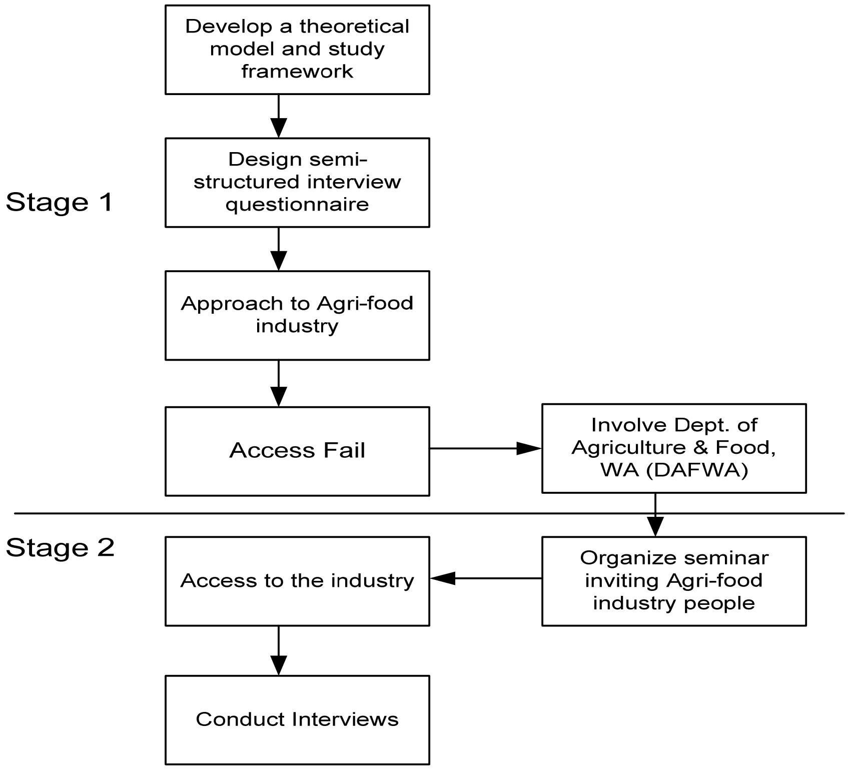
Company Code	Nature of Business	Participant's position	Participant Category	Experience in SC (years)
Firm1	Meat	Executive	Producer	More than 20
Firm2	Vegetables	Owner	Producer	More than 20
Firm 3	Meat	Owner	Producer	More than 15
Firm 4	Food and Grocery	Merchandise Manager	Wholesaler and Retailer	9 Years
Firm 5	Meat	Executive	Processing	7 Years
Firm 6	Biscuits, soups and chips	Logistic Controller	Processing	16 years
Firm 7	Seafood	Manager	Processing	13 years
Firm 8	Food and Grocery Retailers	Distribution Centre manager	Retailer	8 Years

4.2.4 Process of Data Collection

The data collection processes can be described in two stages, as shown in Figure 4.1. The first stage starts by developing the model and framework of the study based on an extensive literature review of relevant studies (the conceptual model developed in Chapter 2), which is followed by designing a questionnaire for the semi-structured interviews. The issues and concepts that are important in the agri-food industry supply chain in the Australian context were developed and then structured into a set of open-ended questions. The process was followed immediately by searching for a convenient sample and access to it in the agri-food industry. In the busy Australian business environment, it was difficult to contact and get appointments with experienced persons in the supply chain or logistics division of a firm.

The researchers were able to get a list of the companies from the government Department of Agriculture and Food, Western Australia (DAFWA) and spent two months seeking appointments by writing, emailing and making phone calls to targeted companies. Although it resulted in two interviews, one of the participants did not allow the interview to be recorded; later it was discarded from the study as the memory-based transcription seemed to be insufficient for a detailed analysis in the study. As the approach apparently failed, a surprisingly similar experience to the study of Chan and Ngai (2007) in Hong Kong, the researcher planned another approach by involving DAFWA.

Figure 4.1 Process of Data Collection



In the second stage, DAFWA organized a seminar 'Profit from Managing Knowledge and Business Relationships in a Supply Chain' inviting almost a hundred WA agri-food industries and associations to participate in the seminar and publicize the study. 15 companies in different sectors of agri-business participated, where the researcher presented the study objectives and benefits in detail. During the networking session the researchers invited companies to participate in the study. The approach proved to be successful as another 7 interviews were conducted within two months; a total of eight interviews, which was sufficient to meet the purpose of the study.

All relevant data were collected through the technique of in-depth interviews following the guidelines of McGivern (2003), such as starting the interviews with a clear introduction and 'warm up', then the main body, and finally a clear signal of ending or 'wind down'.

The interview schedule was arranged based on interviewee convenience, availability and voluntary willingness. All the relevant documents on interview ethics approval, interview topics and the benefits of participation were sent by email to participants well before the appointment and, in some cases, were explained over the phone. Permission was sought to record the interviews for analysis purpose. Thus, the researcher was able to create a more enthusiastic and congenial environment by conducting the interviews where most participants gave details of their industry experiences, examples and scenarios about supply chain performance. Although interviews were conducted in an informal or natural conversation format and the topics were re-phrased as the interview progressed, each interview consisted of the following topics based on which open-ended questions were asked and relevant examples were sought:

i. The supply chain governance structure, i.e., the formal and information transaction arrangements of the companies and their influence in SC performance.
ii. The existing relationship/transaction climate among the stakeholders of the supply chain and its influence in SC performance.
iii. The uncertainties in the supply chain transaction.
iv. The systems of maintaining interorganizational relationships.
v. The role and links of interorganizational systems in SC performance.
vi. The initiatives for developing and utilizing knowledge assets in supply chain and their influence in SC performance
vii. External factors that influence the use of knowledge asset and IOS
viii. The performance indicators used in the supply chain

The list of questions developed from the topics ensured that the conversation stayed relevant to the research topic and investigation (Burns 2000; Nelson 2006). Each interview lasted from 45 minutes to an hour, as typically occurs in this type of research. Discussions in each of the interviews were recorded on a voice recorder device for transcription, enabling checking and re-checking of the key issues, interviewees' opinions, beliefs and experiences (McGivern 2006; Zikmund 2003).

4.2.5 Data Analysis via Content Analysis

The word-by-word transcription of the interviews resulted in a total of 88 pages of content, which were analyzed following a content analysis procedure. NVivo 8 software was used for the analysis to allow organization of each of the interview transcripts, coding and capturing of the important facts, ideas and statements to a relevant topic and, then, categorization of high-level factors, corresponding items and their relationships/links across the interviews. The content analysis was initiated, by focusing to develop the core and sub-themes from one set of interview data, such as transcript of Firm1. The preliminary themes and sub-themes guided the analysis of other interviews, while all the emerging concepts were included as themes or sub-themes and amended later by checking across the interviews, visiting and revisiting the literature, and, where possible, labeling them with the item/variables of past studies. . A combination of both inductive and deductive approach (Strauss 1987, Berg 2001**)** was used to identify the core and meaningful thematic items across the interviews detecting their similarities and differences. Finally, the themes were used to identify a set of common key concepts that linked the related concepts and sub-concepts in the cases to answers relevant to the research question. Finally, to present the results, Miles and Huberman's (1984) approach of a 'conceptually clustered matrix' was employed for noting patterns in the data, summarizing participants' quotations of related ideas and concepts, and grouping them in a table. This resultant 'across-case contrasts' matrix is presented in the findings of the study.

4.3 Results and Discussion

The content analysis of the field interviews using NVivo 8 software resulted in the identification of a total of 10 primary factors, 16 sub-factors, and 129 variables noted in the supply chain performance of Australian agri-food industries. The key variables found to have an important influence in the supply chain performance were long-term relationship, price, profitability, knowledge use, open/spot market use, contracting, chain coordination, trust and growing concern of 'bargaining power' in the relationship. The findings are presented in detail in the following sections.

4.3.1 Demographic Information

As displayed earlier, Table 4.1 presents the nature of business of each participant firm and the respondent's position and experience in the firm. Among the eight participants, three were from farmer/producer firms, three were from processing firms and the rest two are from the retailer/wholesaler firms. Again, three participants represented the meat industry, while each of the other firms was from the vegetables, grain, or seafood industry. The interviewees, except for the owner of a firm, were selected based on their role in the supply chain. Table 4.1 illustrated that all the participants were in senior management positions with more than 5 years of working experience in a supply chain or logistics operation.

4.3.2 Factors and Variables of Supply Chain Performance

The complete list of factors and variables generated using the NVivo 8 software is shown in Table 4.2. In the first column, the table displays high level factors, then the sub-factors, the variables and their frequencies are listed in the subsequent columns.

The main factors are the *external issues, structural issues, uncertainty, transaction climate, contractual arrangement, degree of inter-firm relationship, inter-organizational system use, knowledge asset management, supply chain performance,* and *competitiveness*. Among the 16 sub-factors, the construct *external issues* consist of four sub-factors: *competitors, policy of technology use, environmental issues,* and *trading regulations*. The factor *structural issues* consist of three sub-factors: *chain governance, vertical coordination,* and *power*. The *inter-firm relationship* factor has two sub-factors as: *mutual investment* and *relationship strength*. The factor *knowledge asset management* has four sub-factors: *knowledge creation and learning, access to knowledge, knowledge storage,* and *knowledge utilization.* Finally, the construct *competitiveness* comes from three sub-factors: *efficiency, innovation* and *strategy.*

However, the significance of the qualitative study lies in the identification of 129 variables that influence supply chain performance in Australian agri-food industries, and can be used as measurement items of the factors and sub-factors identified in the study. It is important to note that all eight participants mentioned the variables ‘contract’, ‘chain coordination’ and ‘bargaining power’ while discussing the governance structures of the supply chain. The variable ‘trust’ in the supply chain was also mentioned by all eight firms, although two of them did not believe in trust in the business transaction. Five other important variables mentioned by 7 firms were: p*rice negotiation, price uncertainty, marketing contract, long term relationship,* and the use of an *electronic communication system*. Among the other variables, *demand uncertainty, cost of input, chain cooperation, written contract, breaking of relationships, market knowledge, process experience, operating cost* and *financial turnover we*re found to be very important in that they were mentioned by 6 firms. *Commitment, Food Safety, spot market use, rights and clauses of contract, supply reliability and process efficiency* were important influencing variables mentioned by 5 companies. In terms of the number of variables, the most 83 items were identified from the interview analysis of firm 4, while, 79 variables were identified from Firm 6, followed by 68 variables from Firm 7, and 65 variables from Firm 8. Among the rest, the interview analyses of Firm 1, 2, and 3 (all of which were producers) revealed 47, 35 and 34 variables respectively.

Table 4.2: Factors and Variables in the Performance of Australian Agri-Food Industry Supply Chain

Primary Factors	Sub-factors and Variables	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Freq.
	Competitors									
	Brand influence				√		√		√	**3**
	Absence of competition	√		√						**2**
External Issues	Competitors location				√		√	√	√	**4**
	Policy of technology Use									
	Technology Policy				√		√		√	**3**
	Accuracy in Production	√	√	√						**3**
	Accurate Inventory				√		√	√	√	**4**
	Better firm management			√		√				**2**
	Cost of technology		√	√						**2**
	State of art system				√		√	√		**3**
	Business size						√		√	**2**
	Precision in firming			√						**1**
	Environmental Issues									
	Reducing carbon footprint				√					**1**
	Reducing paper use				√					**1**
	Ethical issues	√		√						**2**
	Food safety		√		√		√	√	√	**5**
	Animal welfare	√				√		√	√	**4**
	Waste management				√					**1**
	Quality of facilities					√	√	√		**3**
	Trading regulations	√	√		√	√				**4**
	Free trade contract					√				**1**
	Increasing Import	√				√				**2**
Transaction climate	Common Goal		√					√		**2**
	Highs and lows of market					√				**1**
	Chain cooperation	√	√		√	√		√	√	**6**
	Sharing of Risk	√	√			√				**3**
	Common Understanding			√		√		√	√	**4**

Table 4.2 continued …

Primary Factors	Sub-factors and Variables	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Freq.
	Chain Governance									
	Contract	√	√	√	√	√	√	√	√	**8**
	Middlemen use				√		√	√	√	**4**
	Spot market use	√	√	√		√			√	**5**
	Active chain partner	√				√	√			**3**
Structural Issues	**Vertical coordination**									
	Grower base supply chain							√	√	
	Streamlined chain						√			**1**
	Chain coordination	√	√	√	√	√	√	√	√	**8**
	Smooth transaction		√				√			**2**
	Cohesiveness					√				**1**
	Integration period						√			**1**
	Chain Integration	√			√	√	√			**4**
	Power									
	Supply value				√			√	√	**3**
	Bargaining power	√	√	√	√	√	√	√	√	**8**
	Market share				√		√	√	√	**4**
	Hold-up problem	√	√	√		√				**4**
	Price negotiation	√	√	√		√	√	√	√	**7**
	Price taker	√	√	√		√				**4**
	Demand and supply game		√					√	√	**1**
	Market influence				√					**1**
	Forward Contract					√				**1**
	Market Contract	√	√		√	√	√	√	√	**7**
Contractual Arrangement	Right and clauses	√			√		√	√	√	**5**
	Delivery terms				√		√	√	√	**4**
	Bilateral contract		√		√		√	√		**4**
	Written contract		√		√	√	√	√	√	**6**
	Unattractive contract	√		√						**2**
	Private treaty		√							**1**
	Input specifying contract					√	√			**2**

Table 4.2 continued …

Primary Factors	Sub-factors and Variables	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Freq.
Uncertainty	Supply Uncertainty				√	√		√	√	**4**
	Demand Uncertainty	√	√		√		√	√	√	**6**
	Uncertainty of weather							√	√	**2**
	price Uncertainty	√	√	√		√	√	√	√	**7**
	Perishability		√		√				√	**3**
	Service disruption				√					**1**
	Uncertainty of transportation				√			√		**2**
	Exchange rate					√				**1**
	Input availability			√		√	√			**3**
	Cost of Input	√	√	√	√	√	√			**6**
	Availability of raw materials						√			**1**
Inter-firm relationship strength	**Mutual Investment**									
	Facility development						√	√		**2**
	Production development	√			√	√		√		**4**
	Use of logistics				√		√			**2**
	Relationship Strength									
	Long term relationship	√	√		√	√	√	√	√	**7**
	Short-term relationship				√		√	√	√	**4**
	Trading term relationship		√		√				√	**3**
	Integrated relationship	√				√	√			**3**
	Inadequate relationship	√		√						**2**
	Breaking of relationship	√		√		√	√	√	√	**6**
	Close relationship					√		√	√	**3**
	Commitment			√	√	√	√		√	**5**
	Interdependence	√				√	√			**3**
	Trust	√	√	√	√	√	√	√	√	**8**
IOS use	Compatibility				√		√	√	√	**4**
	Demand forecast			1	√			√	√	**3**
	Record keeping				√		√	√		**3**
	Demand simulation				√		√		√	**3**
	Electronic booking and picking				√	√		√	√	**4**
	Communication	√		√	√	√	√	√	√	**7**
	Sending/Receiving Order	√			√	√	√	√		**5**
	Electronic System				√	√	√	√	√	**5**

Table 4.2 continued …

Primary Factors	Sub-factors and Variables	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Freq.
Knowledge Asset Management	**Knowledge creation and learning**									
	Data analysis				√		√	√	√	4
	Data Comparison				√		√	√	√	4
	Customer knowledge		√		√		√	√		4
	Employee knowledge				√		√	√	√	4
	Market Knowledge	√	√	√		√	√	√		6
	Process experience	√	√	√	√		√	√		6
	Production knowledge	√	√			√	√		√	5
	Sales data				√		√	√	√	4
	Access to knowledge	√					√	√	√	4
	Scanning				√	√	√	√	√	4
	Sharing agreement				√		√			2
	Knowledge memory				√	√	√	√	√	5
	Data ware house				√					1
	Electronic system				√	√	√	√	√	5
	Knowledge Utilization			√	√		√	√	√	5
	Benchmarking report				√					1
	Sales support	√			√		√	√	√	5
	Customer services				√		√	√	√	4
	Determine shelf space						√			1
SC Performance	Supply reliability				√	√	√	√	√	5
	Supply accuracy				√				√	2
	Responsiveness	√			√			√		3
	Reputation				√		√	√	√	4
	On time delivery				√		√	√	√	4
	Inbound service level				√		√			2
	warehouse efficiency				√		√	√		3
	Operating cost	√		√	√		√	√	√	6
	Expense cost		√	√	√					3
	Wage cost				√					1
	Shelving cost				√			√		2
	Freight cost						√		√	2
	Financial turnover		√		√	√	√	√	√	6
	Return on investment	√		√			√			3

Table 4.2 continued …

Primary Factors	Sub-factors and Variables	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Freq.
Competitiveness	**Business Strategy**									
	Shelf price				√				√	2
	Shelf space				√		√			2
	Market share				√		√	√	√	4
	Outsourcing				√		√			2
	Alternative market	√	√				√			3
	Business Diversification	√			√	√				3
	Innovation	√		√		√			√	4
	Increased productivity	√		√		√			√	4
	Reduce labor cost	√		√		√				3
	Automation					√				1
	Efficiency				√	√		√		3
	Cost efficiency	√		√	√		√		√	5
	Process efficiency	√		√	√		√	√		5
	Order efficiency				√		√	√	√	4
	Load efficiency				√					1
	Pick efficiency				√		√	√		3

Thus, the content analysis of interview transcripts revealed a wide range of issues, dominant factors and variables which, in most cases were labeled with existing variables in the literature on agri-food industries (see Duffy and Fearne 2006; O'Keeffe 1998; Hobbs and Young 2000; Blythman 1998, Bensaou 1997; Nidumolu 1995; Szabo and Bardos 2005; Hall 2000; Aruoma 2005; Bijman 2006; Williamson 1979; 1987; 1991; Schulze *et al* 2006; Vorst and Beulens 2002; Hardaker *et al.* 2004; Sodano 2007; Collins 2002; Revell and Liu 2007; Bunte 2006). Nevertheless, the issues and information revealed from the analysis provided a rich insight; additional items in the inter-firm relationship management, knowledge asset management and inter-organizational system use in the Australian food industries helped the researcher to understand more about the predominant factors in the performance of agri-food supply chain.

4.3.3 Causal Links among the Factors

It was considered important to learn from the practitioners about their perceived understanding of the factors that had a significant link to performance in a supply chain. Practitioners' views were particularly helpful for identifying the important challenges on relevant issues, giving a solid base for further investigation and developing of measures to address issues in the industry. The interview process included discussion of the dominant factors that link to supply chain performance; the degree of importance that the participant felt about whether or not the factors of industry structure, inter-firm relationships, competitions, knowledge asset management and IOS use had a relative high or low level of link to supply chain performance. Later, the participants' views were extracted from the transcripts using the content analysis procedure in NVivo software and consolidated and illustrated in Figure 4.2.

The figure presents the combination of factors, associated variables of a particular factor, and the links between the factors, as identified from the analysis of interviews. For example, based on the opinions of Firms 2, 3, 4, and 8, Figure 4.2 shows that the factor 'power' (with seven associated variables) is linked with the factors 'inter-firm relationship' and 'SC performance', e.g., Firm 4 said: *We are all very significant business for each supplier. We are very fortunate that we do have bargaining power, that's what comes to standard, can we offer value? And we can, because we have a large market share and we can sell a lot of stock for the supplier. So I find it works in our relationship (Wholesaler/Retailer)*; Firm 2 said: *They [buyer] use all sorts of excuses, quality, too much produce around, loss of market, because they buy and they have the market to sell it to … We the farmers are losing. We are price takers, we take whatever price … it's very tough to make good relationship when they make a better bargain and it is inappropriate for us (Vegetables Producer).* The link between power and contractual preference is identified from one of the following comments: *A lot of them [the buyers] wont write a contract for certain time of the year because they know you have to sell your cattle, they know you cant hang on to your cattle. So they say we will pay you less, and we can't wait as price taker… because the product may go over certain weight, over certain grade and specification (Firm 3 - Meat Producer).*

Similarly, the link between inter-firm relationship and SC performance is identified from the comments of seven firms, e.g., Firm 5 said: *We need to look at the ways we can be much more innovative in the industry and how we can work much more cohesively throughout the supply chain where the risk is shared by all the parties … the farmers or producers, the processors and the feed mills, if they all share the risk of supplying a product that will simplify the process (Processor).* The link between Knowledge Asset Management and SC performance is gleaned from the opinions of six firms, e.g., Firm 4 commented: *We need to keep our eyes everyday especially on sales data to know how we are going. Because it affects everything down the lines, logistics and manufacturing supply chain and purchasing of the raw materials (Wholesaler and Retailer).* Firm 2 said: *Our mighty customers create benchmarking report for us, so that we can track how our farm is doing. We can see how we are competing with other firms. Whether our sales are tracking well, or if there is something what we are not doing but the other farm is doing (Producer).* The Link between supply chain performance and competitiveness is drawn from the comments of three firms, e.g., Firm 4 commented: *We are always looking for efficiency, we have a logistics division for ensuring the efficiency in order, loads and quantity… load of full trucks or full container to order by the time, then in the warehouse we are always looking at improving efficiency, the way we handle … to reduce our costs, to reduce our customers' costs, to reduce time, more productivity, things like that … So like others, Woolies and Coles we are constantly looking for efficiency and competitiveness (Wholesaler/Retailer).*

The links between other factors are also drawn the same way based on the standpoint of the firms, which are further discussed in details in the next sections.

Figure 4.2 Combined Factors, Variables and the Links Identified in the Study

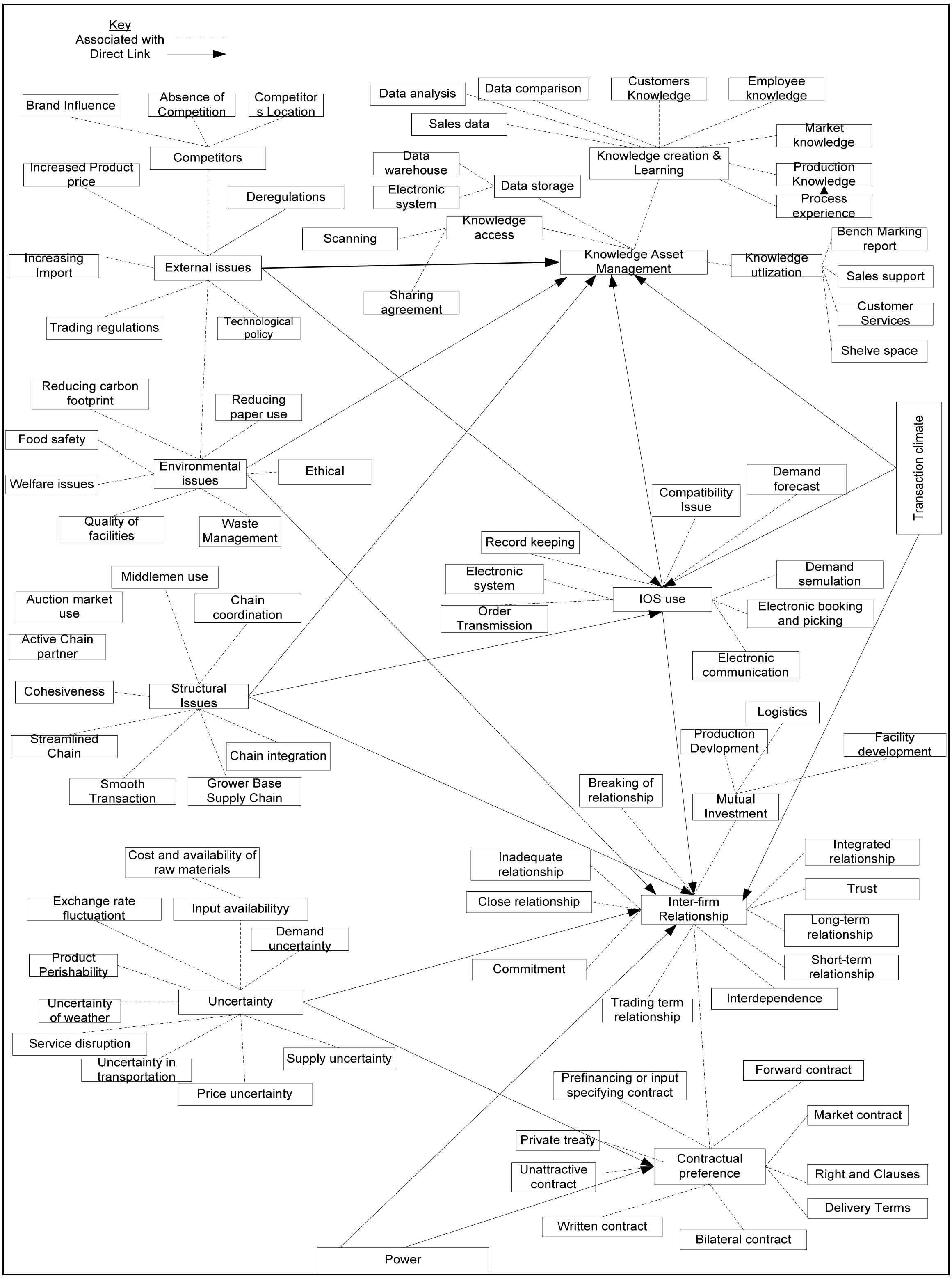
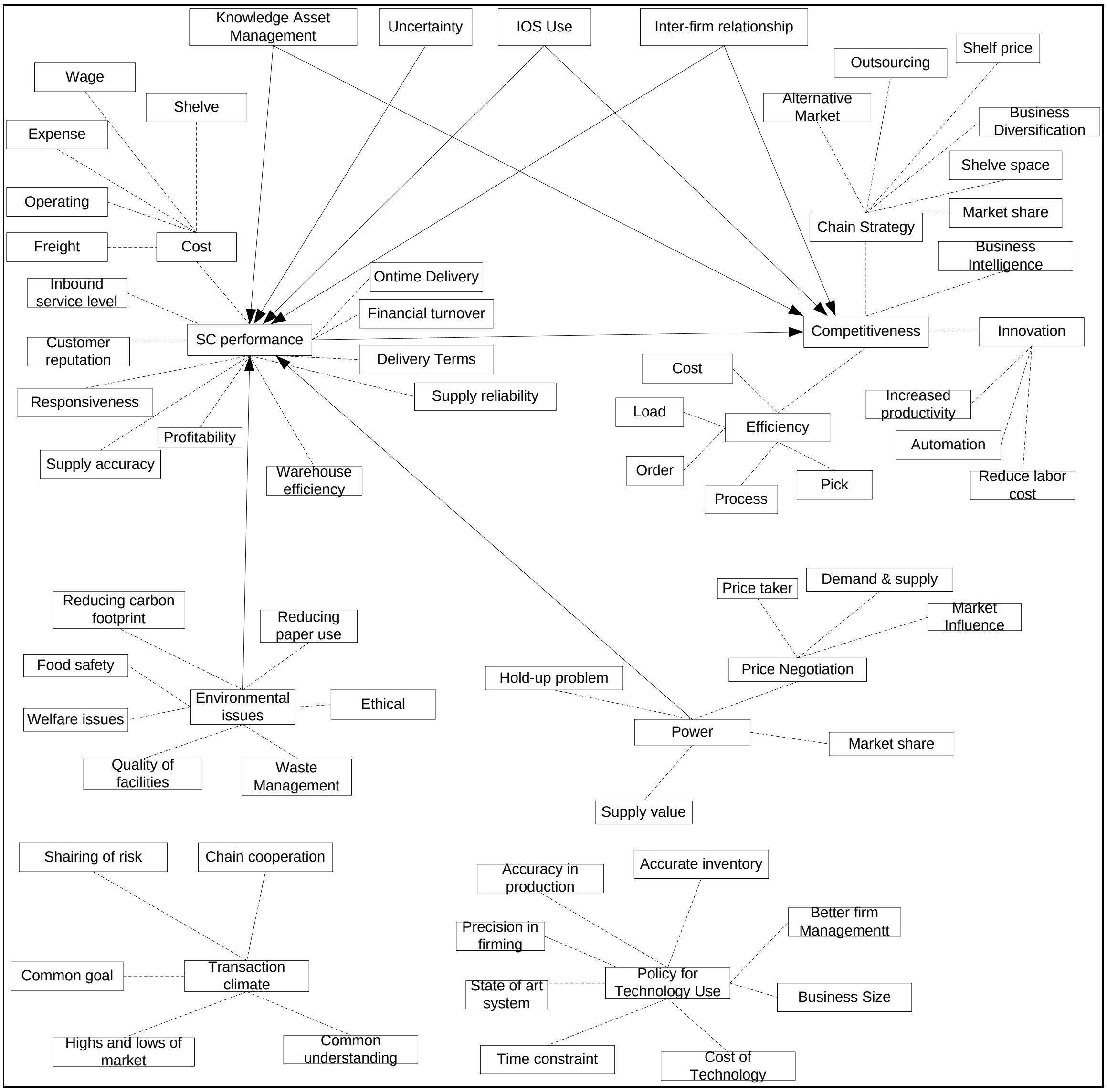


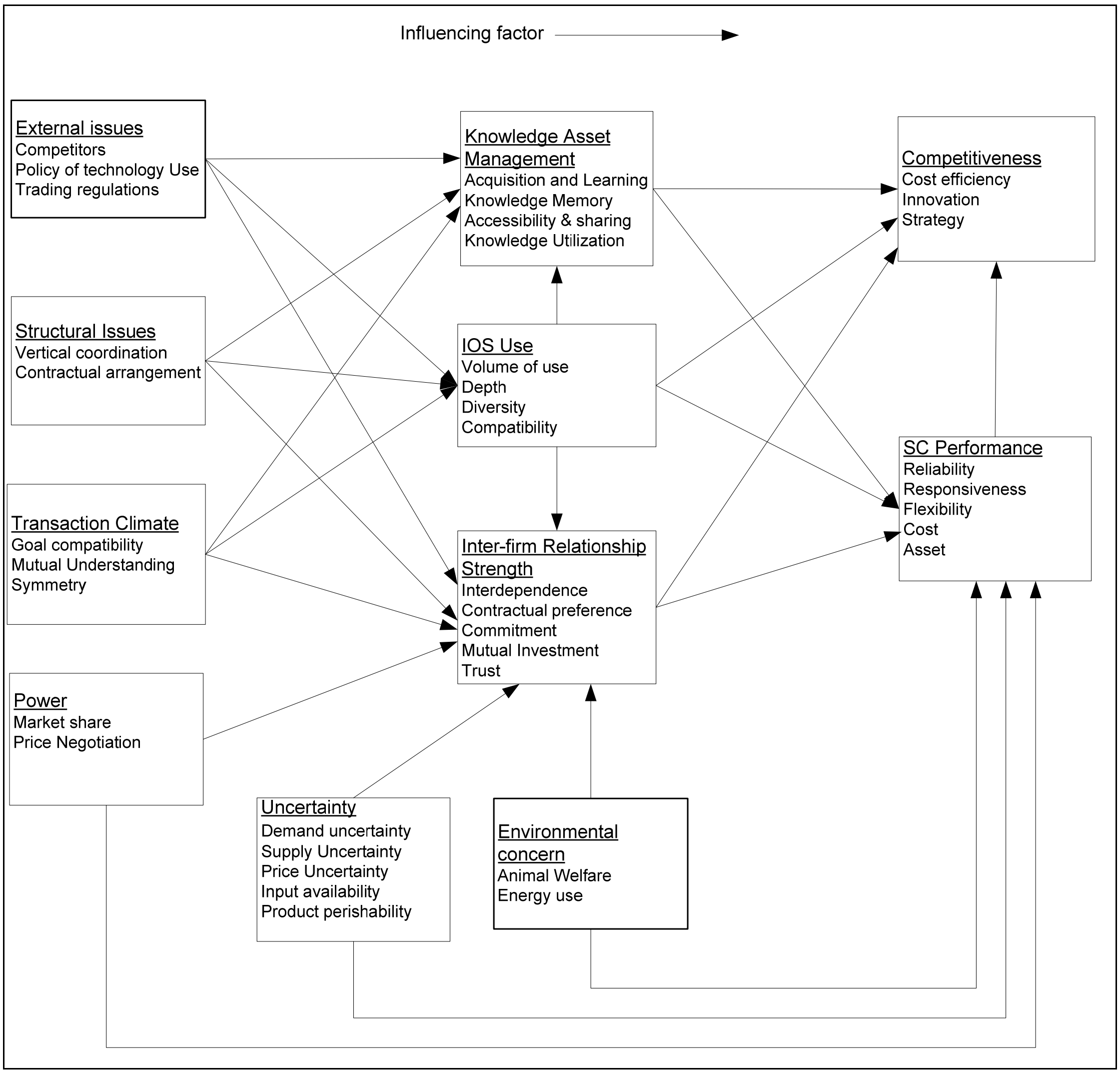
Figure 4.2 continued …



4.3.4 The Combined Research Model

Figure 4.3 below presents a model of SC performance in the Australian agri-food industry, which was developed by combining the key factors, variables and their links as identified from the interviews of the field study; i.e., a refined version of Figure 4.2. As the field study was conducted based on the preliminary conceptual model, the new model can be viewed as an enhanced version of the conceptual model developed in Chapter 2. Compared to the preliminary conceptual model, six new constructs and sub-constructs such as *structural issues, transaction climate, power,* *uncertainty*, *environmental management* and *competitiveness* were added to the new model based on the findings of the field study.

Figure 4.3 The Combined Research Model



The modification and justification for the new constructs was made by revisiting the literature and labeling the factors/variables of the field study with the independent factors/variables of past studies within the framework of TCE, RBV and KBV. Table 4.3 presents the theoretical anchors and arguments for the constructs of the new model.

Table 4.3 Theoretical Anchors and Arguments for the Constructs of the Combined Model

Factors and sub-factors	Theoretical Argument	Theoretical Anchors	Links to literature
External Pressure **- Competitors** **- Policy of Technology** **- Trading regulations** **- Environmental management**	Presence of Industry competitors, aggressiveness of technological policy and issues of environmental sustainability determine firm's competitive ability and lead to supply chain innovation.		Miles and Snow 1978; Daft *et al.* 1988; Jeeva 2004 ; Ettlie 1983; Grover, 1993; Priem *et al.* 2002; Porter 1990; Bourgeois 1985; Buchko 1994)
Structural Issues **- Vertical coordination** **- Contractual arrangement**	Inter-firm exchange process creates transaction costs and to minimize these costs adequate supporting mechanism must be set up for efficiency of transactions.	TCE	Coase 1937; Williamson 1979; Szabo and Bardos 2005; Hobbs 1996, 2000; Duffy and Fearne 2004.
Uncertainty	Level of uncertainty in the agri-food chain act as determinant of inter-firm relationship and supply chain performance.	TCE	Hobbs, 1996, 2000; Bensaou and Anderson 1999.
Power	The profitability and outcome of inter-firm exchange depends on the behavior of powerful party.	TCE	Maloni and Benton 2000; Sodano, 2006
Transaction climate	Compatibility in goals and fairness in sharing the risks, benefit, and burden equally in the relationship reduce opportunistic behavior and increase cooperation and chain performance.	TCE/RBV	Bensaou 1997; Reve and Stern 1976, 1980; Nidumolu, 1995, Duffy and Fearne 2004.
Inter-firm relationship Strength **interdependence** **commitment** **trust** **contractual preference** **mutual investment**	Firms reduce transaction cost by forging collaborative relationship, close coupling of processes, and extensive information exchange, which contribute increased competitiveness and performance.	TCE/RBV	Saeed, Malhotra and Grover 2005; Williamson 1975, 1985; Duffy and Fearne 2004.
Knowledge Asset Management **Acquisition and learning** **Knowledge memory** **Knowledge access and sharing** **Knowledge utilization**	Relative ability to build and utilize strategic internal resources and capabilities in Supply chain leads to firm's competitive advantage and eventually to improve performance.	RBV/KBV	Grant 1996; Hult et al. 2006; Ketchen and Hult 2007; Barney 1991; Wernerfelt 1984.
Inter-Organizational System (IOS)	Inter-organizational system reduces information, communication, and coordination	TCE/RBV/KBV	Saeed Malhotra and Grover 2005; Radhakrishnan

	costs and provides improved efficiency, competitiveness and better performance.		2005; Sahin and Robinson 2002; Saeed *et al.* 2005
Supply Chain performance	Supply chain can be inimitable competitive weapon when combined with strategic focus on inter-firm relationship and knowledge exchanges, and economic focus on the organization of market and transaction.	TCE/RBV/KBV	Supply Chain Council 2004; Gunasekaran *et al.* 2004.
Competitiveness	Firms actually achieve competitive advantage by leveraging the management of their supply chains.	RBV/KBV	Porter 1985, Han *et al.* 2007; Fearne 2008; Ketchen and Hult 2007.

The following sections have explained the findings of the field study, the justification of the key factors and variables, and the links drawn in the combined model.

4.3.4.1 External factors in the food industry supply chain

The field study found evidence of some dominant factors external to the agri-food chain such as the presence of competitors, the policy of using technology, environmental sustainability and regulatory issues that can influence the performance of the agri-food supply chain in Australia.

Competitors

Studies support the view that competitors have a significant role in determining strategic goals in industries (e.g., Buchko 1994; Bourgeois 1980) and can enhance a firm’s ability to differentiate itself by serving as a standard of comparison (Porter, 1985). Among the eight participants, five firms indicated they were influenced by their competitors who drive them to take necessary action in the supply chain; e.g., an alliance between the processor and retailer enhanced co-innovation and promotion of the product, sales and cost efficiency of their supply chain. The evidence is demonstrated from the following statements of Firms 4 and 6.

I mean a lot of what we might see in here especially in the supply side is driven by a company like Wal-Mart. If they said, we want you to start packaging your product like this, and that will follow through the world. We will make change because Wal-Mart is such a significant business term that affect Australian market … Woolies and Coles, they also always drive us (Firm 4 – Wholesaler/Retailer).

If you look at the supermarkets, there are lots of home brand products that are the major price selling product. We need to ensure that our product is at the high level, and it's what the customers buy. Just because Woolworths and Coles are using their home brand products cheaper than ours does necessitate the importance of managing better products for the consumers to buy (Firm 6 – Processor).

Market share is the main issue where we always work very closely to make sure that we are maintaining it and growing it. Because of that we need to know what our competitors are doing, what are the qualities of their brand; we track that our market shares are growing and have not been beaten by any competitors (Firm 6 – Processor).

The above statements reveal that competitors both from national and international firms drive the business strategy of the agri-food companies into developing better products, becoming more cost efficient and growing market share. Absence of competition may adversely influence productivity and efficiency, and may create a major difference in the performance of a firm and its profit margin, as demonstrated from the following comments from meat producers (Firms 1 and 3):

There is no competition in the market, really no competition in the WA market. If you got sellable cattle at the moment you got to get them to the abattoir, you will get the worksheet if you are lucky. They will tell you that they will handle it within 3 weeks or 4 weeks time. That's not really competition. That's just a feel that your cattle are in the abattoir … we can almost double our productivity if we want to, but there is no money in building it, and there is no one helping to build it, then we actually reduce the productivity (Firm 3- Meat Producer).

At the end of the day we basically have to rely on the long term integrity of the processors or with other sectors of the supply chain. Where in the auction system there would be one or two buyers buying for 5 or 6 companies, they will collude with another buyers … will get together and say that if you buy that pan of cattle, I will buy this pan of cattle. Because there is an absence of competition, the producers are spineless, because at the end of the day as a producer you can't have, you don't have, any income target (Firm 1- Meat Producer).

Policy of technology use

Use of current technologies among the stakeholders in the supply chain is important; not only that they can offer better firm management or precision in farming but they can also work as a collaborative tool with other partners to communicate, exchange transaction information, increase speed and reliability in procurement and lead to cost savings and competitiveness. Supply chain technology offers integration of the partners, improved market penetration and protects market share (Patterson *et al.*

2003). The following statements from the processing and retailing firms illustrate the point:

We are always making sure technologies that are out there we are using them with the best of our ability to ensure that we can run more competitively in our supply chain, to ensure that we are keeping the customers happy (Firm 6- processor).

Technology in the agri-food sector is certainly right there, with all the latest technologies like any other industry … use of these systems reduces the price, the cost of production, and that's the only reason we are surviving in this industry by reducing the cost of production (Firm 3- Meat Producer).

In our sales we use state of art of technologies …. we are looking how to make our labor more efficient, how to manage stock … and anything like that and absolutely we got a whole division who are specialized on that … our company always looking for new technologies and logistics (Firm 8 – Retailer).

However, adopting technology in a firm requires an initial investment, which makes some firms, especially the producers, skeptical about using it because of the issue of affordability; although, they realize that technology can offer them greater precision in farming and can keep their production costs down. The evidence of the statement is demonstrated from the following comments of Firm 3 and 4.

You may get precision in farming as there is some good technology out there for that. Then you have to afford it. You have cost to handle. So technology can improve your efficiency. There is staff out there, but compared to the cost whether you can afford them, that's a big question (Firm 3- meat producer).

Local growers, a lot of them in fresh foods own family businesses. They don't use EDI technologies. We are always looking to how we can improve them and help, and how to deal with these people who are decade behind. We are, and we need to be, because it adds cost to the supply chain, and that's cost to our customer (Firm 4 - Wholesaler/Retailer).

In the first case, the importance of the comments lies in the affordability of using technology in the firm, even though there is a perceived benefit at the producers' level. In the second case, evidence from the wholesaler/retailer illustrated how inability to adapt to new technology can affect inter-firm transaction costs in the supply chain; and why firms are willing to assist and improve the use of technology among the primary producers.

Environmental issues

Food is a critical issue across public health, the environment and the economy where a growing recognition is that significant environmental burdens are associated with the system of food production, packaging, distribution and marketing (Jones 2002). Therefore, the process through which food is produced, sourced, distributed and marketed increasingly has been a focus of attention for consumers, environmental groups, policy-makers and the food producers (Blythman 1998; Jones 2001; Hall 2000; Pretty 1998). Some authors argue that there are parallels between environmental management practices and supply chain management practices that may lead to overall business efficiency (Lamming and Hampson 1996). During the field study, three participants expressed their deep concern with environmental issues such as food safety, waste management issues, welfare issues, transportation ethics and legislative concerns related to reducing carbon footprints; e.g.,

Constantly we need to improve our environmental policy, environmental sustainability, that's a big one now. That's going to drive us to be more efficient in the use of power, use of petrol and diesel, things like that, and water (Firm 6 - Processor).

So as a push (environmental management) there are two benefits for that. Sometimes it is a cost benefit - means it has pushed us to the electronic system, which is a benefit and saving in terms of using less paper and things like that. There is environmental benefit there as you are reducing your carbon footprint, which is very critical. So that is a push by our concern, our environmental awareness. It is also becoming a push from the consumers to prove that we are good corporate citizens (Firm 4- Wholesaler/Retailer).

The above statements indicate there is environmental concern in the food supply chain; about how to use energy and control carbon footprints by reducing use of power, paper etc. The companies also emphasized that these issues can be addressed by using technology and inter-organizational systems, by better inter-firm relationships, and by sharing information and knowledge among the stakeholders, while for one of the companies environment concern was a notion of good corporate citizenship and that's how they wanted to grow their business reputation to customers.

Trading regulations

At all stages of the food supply chain, from farm to consumers, regulations have an important impact on increasing economic viability, harmonizing well-being and engendering fair trade on foods (Aruoma 2006). The field study provided some insight of the regulatory and deregulatory effects on supply chain performance in Australian food industries. Some firms expressed their concerns about regulations in balancing the power in inter-firm transactions, reducing carbon footprints and increasing opportunities in export market. One participant raised the issue of the impact of deregulations as a factor in becoming competitive in the market.

4.3.4.2 Structural issues

The term structural issues refer to the governance structure (Bijman, 2006) of a firm. It can be applied to agri-food industries and was developed from institutional economics from the classic work of Coase (1937), Klein et al. (1978) and Williamson (1975, 1985 and 1991). The main point of institutional economics is that any exchange between two firms in a marketplace incurs a cost, known as transaction cost, such as the cost of finding a market or a trading partner, negotiating and monitoring an agreement, and the enforcing of contracts. These costs determine how a firm will be organized and the structure of inter-firm transactions developed. The field study found some important factors related to the structures of Australian food industries as explained in the following sub-sections:

Contractual arrangement

In governing the food industry supply chain, all the processing and retailing firms focused on formal arrangements such as contracts and property rights for governing the buyer seller transaction. The important comments, presented in Table 4.4, demonstrate that firms are relying on contracts to arrange their transaction structures in the supply chain for ensuring the required quantity and quality of products, a stable price and schedule of product delivery through the supply chain. For example, *We build the relationship based on contract. Basically we issue a letter or contract of what we require, how we require; we will work with them in freight or transport side,* *we offer them our services for sales or they may want to do it by themselves depending on the cost* (Firm 8 - Retailer).

Table 4.4 Findings on the Governance Issues and Link on Firm Performance

Question	*Firm Code*	*Excerpts of data on contractual arrangement*
What is the method of organizing your inter-firm transaction in SC? Is it based on contract or open market?	Firm 2	*Produce particularly vegetable crops price in the spot market is very uncertain, and no longer can we have some days 10 dollars a box, some days 8 dollar or some days 1 dollar a box. We need contract to ensure the price … because you know what you will get … and you know that you have a market to sell (Producer).*
	Firm 3	*We prefer to sell our products at auction. Contract is nothing. If I had an attractive contract, I may treat it contract. The contract may blow you by the cost of production; better follow how the market goes up. Even though the contract for lamb or sheep was not too bad, I found it not profitable. That's why this year I did not do the contract for lamb because the market was zero when they offer the contract (Producer).*
	Firm 4	*These days there are lots of businesses who are smart enough and always been on contract. Our business relationships also always work on contract, because there are many issues for which we don't want to go down … If you have contract in written, and is understood by both parties, then you should know what issues are there for all (Wholesaler/Retailer).*
	Firm 6	*We have contracts with our main suppliers. We have a contract in terms of deliveries which should be signed up. We have a contract with our distributors too that there is a minimum quantity to take an order from us to located delivery (Processor).*
	Firm 7	*We make a trading term relationship with a business deal, we have terms of trade with them - say this is the things that I am going to invest and that's the thing we want from you. We will advertise the product and do that sort of stuff and if you agree on it, set the trading terms, and then just supply the products (Firm 7, Processor).*
	Firm 8	*We build the relationship based on contract. Basically we issue a letter or contract of what we require, how we require; we will work with them in freight or transport side, we offer them our services for sales or they may want to do it by themselves depending on the cost (Retailer).*

Participants stated that they use contracts for making investment or promoting the products, which is important to ensure their brand image among the customers. For example,

We make a trading term relationship with a business deal, we have terms of trade with them - say this is the things that I am going to invest and that's the thing we want from you. We will advertise the product and do that sort of stuff and if you agree on it, set the trading terms, and then just supply the products (Firm 7, Processor).

At the producer's level, vegetable growers also prefer a contractual relationship. For instance Firm 2 said: *Produce particularly vegetable crops price in the spot market is* *very uncertain, and no longer can we have some days 10 dollars a box, some days 8 dollar or some days 1 dollar a box. We need contract to ensure the price … because you know what you will get … and you know that you have a market to sell.* The finding is in line with the studies of Guo *et al.* (2005) and Schulze *et al.* (2006) where authors found contracts are a highly preferable option for vegetable producers in relation to bringing down the price risks.

However, the study found the opposite scenario in the meat industry where the producers preferred the open market system rather than a contract; they didn't find it attractive for their profitability. The picture is better depicted by the statement of Firm 3:

We prefer to sell our products at auction. Contract is nothing. If I had an attractive contract, I may treat it contract. The contract may blow you by the cost of production; better follow how the market goes up. Even though the contract for lamb or sheep was not too bad, I found it not profitable. That's why this year I did not do the contract for lamb because the market was zero when they offer the contract (Meat Producer).

Contract length

Short, medium and long term contracts can be found in food industry chains (Szabo and Bardos 2006) but their studies found evidence that the benefit of contracting varies with the duration of contract. A longer contract period can be related with tighter collaboration and better performance in supply chain. The following comments from Firms 6 and 8 demonstrate the point:

We signed the Linfox contract because they like us to stay on board with them for longer term. They will give us concessions; build a new warehouse in Queensland if the contract is for five years, things like that. So if the contract suit enough we could sign it for a longer term (Firm 6 - Processor).

Besides, there is a lot of cost in this side of business which they can't cover [suppliers], and for them if they don't have some sort of long term dealings with someone fairly stable … they may have difficulty (Firm 8- Supermarket Retailer).

The above statement shows that firms prefer a long term contract, especially when there are more concessions and benefits from the relationship. One firm considered that long term dealing is especially beneficial for the supplier as it may decrease their cost of transactions. The length of the contract also depends on commitment to its rights and clauses. Some firms review the contract regularly after a certain period and re-contract the party if it is deemed suitable, for example; *there are specific rights and clauses in the contract where we could terminate the contract if we needed depending on the circumstances … after twelve months we do make a revision of the contract, there are rights and clauses that obviously need to go through (Firm 6 – Processor).*

Formality

Two types of contracts can be found in the food supply chain - formal (written) and informal (oral) - based on specific legal requirements and social bondage (Szabo and Bardos 2006). The field study found that almost all the firms tend to use a written contract for solving issues in inter-firm transactions. The statements from Firms 4, 7 and 8 show the evidence

At this stage without a written contract it would be very difficult to conduct the business. You have got the media, your customers, so you got all of those people to think about (Firm 8- Supermarket Retailer).

If you have a contract written, and understood by both parties, then you should know what issues are there for all. So most of the businesses these days are based on short-term or long-term contracts (Firm 7 – Processor).

No, they are all formal. I mean the majority of stuff is written in trading terms (Firm 4 – Wholesaler/Retailer).

While asking whether the firms are maintaining any informal transactions based on social bondage or trust, most participating firms indicated that they don't have any informal contract, although for the day-to-day transactions they rely on trust and bondage of the parties. The evidence for this statement comes from the following comments:

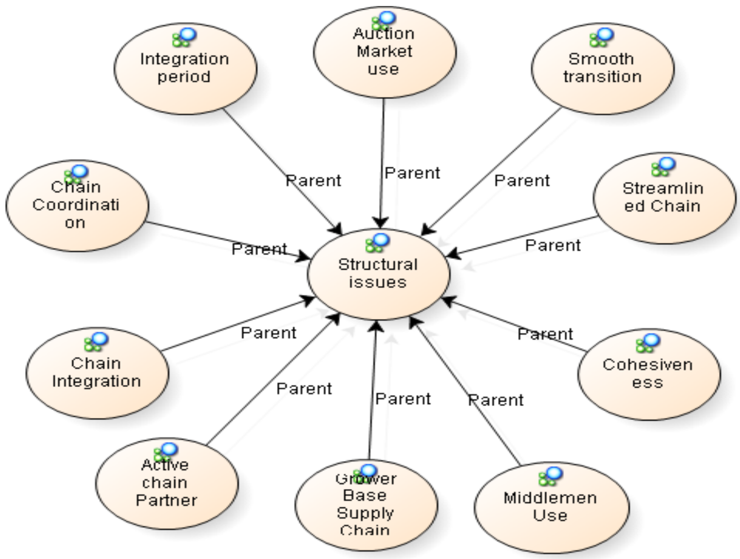
All the legal stuff is written, all the stuff relating to money. But then, obviously, you are dealing with these people week to week, their plan, promotions and like that, you don't write everything … but you can negotiate on how you drive their business, and how you drive sales throughout the year (Firm 4 – Wholesaler and retailer).

We cant deal with anyone unless they are listed on the books with us as a supplier … they need to have a quality assurance program, if they have not got that put in place, we can't deal with them either (Firm 8 – Retailer).

Vertical coordination

Vertical coordination refers to how the structure of producers, processors and retailers are organized in the food supply chain so that each successive stage in the production, processing and marketing of a product is appropriately managed and interrelated (Schulze *et al*. 2006; Hobbs and Young 2000) Agricultural economists believe that vertical coordination is particularly important in the agri-food industry because of its complexity, the large number of firms that participate in one or more stages of a buyer-supplier relationship and the requirement of specific quality and freshness of products. Vertical coordination ranges from open market (spot/auction) transaction to full vertical integration and includes intermediate forms such as strategic alliances, joint ventures, contracting etc. (Mighell and Jones, 1963; Hobbs and Young 1996). Figure 4.4 shows the factors and variables in the vertical coordination of supply chain (derived from the content analysis).

Figure 4.4 Factors and Variables Related to Vertical Coordination



The study found that none of the firms is vertically integrated, although the processing and retailing companies (Firms 4, 6, 7 and 8) are having some sort of vertical coordination by making a direct relationship with their contracted growers/suppliers. They are also utilizing other market sources starting from the spot market to their contracted suppliers to meeting the demand of customers. Table 4.5 presents the relevant comments. For example, Firm 8 stated: *Our basis is the grower* *base, on top of that we got our central market, and brokers on top of that because if a grower does not have enough for some reasons or things go wrong, we need to have a back up plan, from where we can source it … if the grower base does not produce what we need then we go to others, we don't close any door anywhere (Supermarket Retailer).*

The study revealed that retailing firms are maintaining almost a similar supply base for sourcing fresh meat and vegetables; a grower base, on top of that the central market and then brokers on top of that. Because of the supply and demand uncertainty, weather uncertainty and the required freshness of the perishable product, retailing companies said they don't close any doors of supply anywhere. Quality is a major concern; because of that some processors are strictly maintaining vertical coordination such as Firm 6 said about the specific flavor of flour that they need for some of the products can only be supplied by their contracted growers.

Table 4.5 Findings on the Level of Vertical Coordination and Link on Firm Performance

Question	***Firm code***	***Excerpts of data on Vertical coordination***
What is the level of your integration in making inter-firm transaction?	***Firm 1***	*The processors and retailers have to go out and be part of the primary supplier and recognize that the producers are integral part of the chain as they are. Say I am a beef producer from down the road, and I started growing all the good things about my beef, they don't care, they just want the cheapest beef in the window, what they can sell quick. They do not care whether we talk about cattle nice, whether we care our cattle, whether we feed healthy organic material for our cattle (producer).*
	Firm 4	*We have contracted growers for fruits and vegetables … but in the meat division we actually have, a lot of wholesalers out there, they come directly to our stores (Wholesaler/Retailer).*
	Firm 5	*A lot of companies are understanding the importance that there has to be a greater level of integration between the processors and farmers … the processors can set earlier working terms with the farmers to reduce the cost of feed and grain or any issue like that. That will help the farmers sustain the business (Processor).*
	Firm 7	*When we are dealing with a smaller amount of products, it is very hard for us to deal with very small or smaller farming operations, so some of these agents or brokers we might call them, they bring together a whole group of like twenty different small growers, and they are able to supply through the chain that way, which is a benefit to us because when we are rolling out we don't need to deal them (Processor).*
	Firm 8	*Our basis is the grower base, on top of that we got our central market, and brokers on top of that because if a grower does not have enough for some reasons or things go wrong, we need to have a backup plan, from where we can source it … if the grower base does not produce what we need then we go to others, we don't close any door anywhere (Supermarket Retailer).*

However, the producers both from the meat and vegetables industries stress the issue of more coordination from the other sectors of the supply chain. The producers (Firms 1, 2 and 3) and a processor (Firm 5) accepted that that there has to be a greater level of integration between producers, processors and retailers where the downstream partners should recognize that producers are an integral part of the chain that can help to improve their cost structure and profitability. For example, Firm 1 said: *I can produce beef, twelve month in a year, my cost of production allows me a profit, given climate, given things out of my control for about seven months of the year. Now if I was paid enough to subsidize my extra cost of producing a product out of season, I would then be able to do that (Producer).*

4.3.4.3 Power

During the study, the following variables were identified as related to the bargaining or market power in the food chain and as a strong influence in the inter-firm relationships, contract management and chain performance.

Market share

The power of a food company in the supply chain is positively related to the importance of economies of scale in manufacturing, retail concentration, and brand penetration of the market; the power increases as the company's specific investment increases and product quality increases (Collins 2002). The evidence for the statement was found in the field study, where four out of the eight participants accepted that larger market share and brand penetration in the market is related with their bargaining power. The following three comments from the both processors and retailers (Firms 4, 6 and 8) demonstrate the point:

We are all very significant business for each supplier. We are very fortunate that we do have bargaining power, that's what comes to standard, can we offer value? And we can, because we have a large market share and we can sell a lot of stock for the supplier. So I find it works in our relationship (Firm 4 – Wholesaler/Retailer).

Market share is the main issue where we always work very close to make sure that we are maintaining it and growing It ... It is a value that helps us get bargains with the buyers. Based on our sales data we can ask our retailers for more shelf space to display our products (Firm 6 - Processor).

It's a value, if they [the supplier] are getting value, and if their sales are going well and our sales are going well, then the relationships are working. That's certainly what happening in WA; we give suppliers a lot of value, we do lot for them and they get good sales (Firm 8 - Retailer).

In fact, the above findings point to how the companies are gaining bargaining power and/or market power through a larger market share which offers suppliers a value for their product marketing and sales, and offers buyers a value on sales and profit. This power relationship is important and influences the supply chain performance; the study shows that a positive pro-active supply chain is only enforceable, or likely to emerge, when there is consistent direction in dominance or interdependence among the chain participants (Revell and Liu 2007). However, some studies have found that if processing, distribution and retailing firms abuse their market power, the farmers' share in consumer expenditure in the food chain may decrease (Bunte 2006). From the field study, evidence of this statement is demonstrated by the following two comments from meat producers:

[The buyers] are cutting our cost absolutely minimum, so you got some money to live on! If you are trying to keep your production high, you need to reduce your cost, and that's very dangerous because we are controlled by the weather … if something goes wrong with the season, you will be in strife, you may got lots of skinny stock (Firm 1 – Meat Producer).

They discounted a world class product to a level that's not sustainable for us to keep producing and that's why in this area, there are now only five full time farmers and it used to have been thirty once, while this is one of the most reliable places in WA for farming (Firm 3 - Meat Producer).

The frustration that showed in the above statements is generally common in the upstream food industry as the producers have less bargaining power although it is growing at the wholesalers' and retailers' nodes. It may push the food chain from competitive (i.e., spot markets and complete contracts) to imperfectly competitive environments made up of incomplete contracts where large firms usually try to appropriate as much value as possible for themselves on the basis of their critical assets, controlling resources or based on the circumstances that give them bargaining or market power. The following comment from the field study illustrates the point:

A lot of them [the buyers] wont write a contract for certain time of the year because they know you have to sell your cattle, they know you cant hang on to your cattle. So they say we will pay you less, and we can't wait as price taker… because the product *may go over certain weight, over certain grade and specification (Firm 3 - Meat Producer).*

The importance of the statement lies in how a contract can be incomplete and may create a hold-up problem for the producers. In Hungary, Szabo and Bardos (2005) found that even though there was some written contract, food processors often change terms of contracts by arbitrarily using their power and causing hold-up problems (exploiting the vulnerability with perishable products) for the producers who have relation-specific investments. They suggest that producers should come up with an organization (producers' group, co-operative etc.) to increase their bargaining power. Chains with overall buyer or supplier dominance are most likely to experience adversarial effects as one of the producers from the field study realized; *when there is more bargaining power, it is tough to make good relationships.*

Price negotiation

Pricing in the food supply chain is highly relevant with the perishability of the products, uncertain demand and supply situation. It was found that for most of the fresh products, contracts between the parties are made without specifying the price. While buying firms react instantaneously in negotiating the suppliers' price depending on the current market value; it may not be the value they promised beforehand. The evidence for this statement comes from the following statement from Firm 8:

The most of it [pricing] is set on the market value. We negotiate the price week to week, we do re-negotiate day to day, but most of the stocks are pre-sourced a week out. So we start pre-sourcing stock next week, with the existing people. We look at price for the following week and you know things can change. For example, when stocks are coming for the following week and we find that there are lots more available, then we ring and re-negotiate sometimes. Sometimes we find that we are in short of supply, and we re-negotiate there as well, so it's pretty loosely based on market value (Firm 8 - Retailer).

The above statement shows how a retailing company negotiates the price of fresh produce. They negotiate price a week before the stock comes in and they can even re-negotiate the price depending on the market value. Retailers also source their products from many suppliers as well as from spot markets to avoid a 'hold up' or supply shortage situations where producers, in case of short supply, may demand more than the actual price. However, market power seems to have a major policy concern in that it influences the price determination in addition to the demand and supply game in the food chain. The evidence of this statement demonstrated in the following two comments from Firms 1 and 2.

We don't have any market power in the meat industry. We got no control or influence over the price. You had to sell your cattle, because of the stocking. You have the stock, butchers know it, abattoirs know it, and so they determine the price (Firm 1 - Meat Producer).

They [buyer] use all sorts of excuses, quality, too much produce around, loss of market, because they buy and they have the market to sell it to … We the farmers are losing. We are price takers, we take whatever price … it's very tough to make good relationship when they make a better bargain and it is inappropriate for us (Firm 2 - Vegetables Producer).

One of the important facts found from the meat industry, as evident in the above comments, is the time pressure on meat producers. It impacts on their product price as they can't hold their product because of losing a certain weight and grade. The risk of losing grade and overstocking pushes them to sell their products at whatever price is offered from other sectors of the supply chain. Hobbs (1997) also found that grade uncertainty has a major influence in price negotiation where producers feel there is a risk that their products may not sell.

4.3.4.4 Transaction Climate

The concept 'transaction climate' was originally introduced by Reve and Stern (1976, 1986) to describe the sentiment existing between parties making transactions. It has been suggested (Bensaou 1997, Clare *et al.* 2005; Duffy and Fearne 2004; Nidumolu 1995) that some behavioral factors in transaction relationships, such as the compatibility in goals and fairness in sharing the risks, benefits and burdens equally in the relationship, may diminish the opportunistic behavior of the partner and can increase cooperation and performance in the supply chain. From the field study the following factors were identified as directly influencing the inter-firm relationship and supply chain performance:

Goal compatibility

Compatibility in achieving each other's goals and the broader perception of setting the priorities to achieve common goals has an important influence on supply chain transactions (Reve and Stern 1976; Bensaou 1997). The evidence of the statement is demonstrated by the following two comments:

Anyone wants a new customer vendor, we meet with them, we believe what the term is, what the goal, we always do what we can, visit their facilities and look at their labor ... see everything with them goes right (Firm 6 - Processor).

We set a best time to promote their [supplier] product, they give us a window, say in January we will have a lot of cauliflowers we can promote it then, so we try to plan that out, we work out a rough price what we are thinking we could sell it for, and we negotiate it (Firm 8 - Retailer).

The above statement shows that when companies meet with a new vendor, they set the terms and goals together, try to look up each other's facilities and set a mutual business plan to achieve their goals. They also explain that in the vegetables chain, both the buying and selling firms work together in negotiating the price and setting up the promotional plan to attain a common objective. However, some producers felt that they are not treated in the same way as others in the supply chain stream and emphasize that processing and retailing firms should try to be a part of the primary suppliers and recognize that the producers are an integral part of the chain. It will help them to work in achieving a common business goal and will increase performance in the chain.

Mutual understanding

Mutual understanding between the buyer and seller has a positive impact on the performance in the agri-food chain. It can increase the level of confidence among the suppliers and can reduce many unexpected frictions which are important for developing a long-term relationship. For example, Firm 2 stated that: *If you don't have a common understanding in your relationship, it will be hard to work through. Say, when our buyers ask the best time to promote our product, we give them a window, say in January we will have a lot of cauliflowers we can promote it. Then, we try to plan that out; we work out a rough price that we are thinking we sell it for (Producer).* Firm 6 said: *Anyone wants a new customer vendor, we meet with them,* *we believe what the term is, what the goal, we always do what we can, visit their facilities and look at their labor ... see everything with them go on right (Processor).*

Firms invite suppliers to show off their facilities, develop understanding about what they consist of and solve problems that may arise in deliveries. While the supplier should know the effect of failing to meet the required quality and demand, the buyer should know the limitations of the sellers in delivering the product. Perception and broader understanding of each other’s work, as well as awareness of the limitations, help both parties work more cohesively and increase performance in the chain as a satisfied buyer firm shows: *we also see from their side what we can do, pick an order and get it to sell.*

Shared risk and benefit/symmetry

The existence of equality and respect in a relationship, with the commensurate sharing of risk and benefits, may influence the performance of the agri-food chain. The notion comes from studies where the authors argued that partnerships should be based on symmetry of relationship (Clare *et al.* 2005) with a presence of an equal sharing of risks, burden and benefits between the two firms (Bensaou 1997). The current study also revealed strong evidence of a symmetrical relationship in firm performance from four participants (Firms 1, 2, 5, and 8) who accept its role in improving the relationship and performance. For example, Firm 5 pointed that: *the relationship should emphasize getting highs and lows equally in the market place. It means the farmers or producers, the processors and the feed mills, if they all share the risk of supplying the product that will surely impact on a sustainable performance.* One producer explained the process as: *the producer and processor have to share in the fluctuation of market … the risk should be shared, so should the price. If I am the processor and I offered you a price, but if the auction market exceeds that price, I will pay you half the difference. If it drops, you pay me half my difference. That’s reasonable, common with the approach of some larger companies (Firm 1 - Producer).*

Table 4.6 Findings on the Relationship Issues and Link to Firm Performance

Question	*Firm Code*	*Excerpts of data on/mutual understanding*
How do you think mutual understanding in SC relationship have impact on your performance?	*Firm 2*	*If you don't have a common understanding in your relationship, it will be hard to work through. Say, when our buyers ask the best time to promote our product, we give them a window, say in January we will have a lot of cauliflowers we can promote it. Then, we try to plan that out; we work out a rough price that we are thinking we sell it for (Producer).*
	Firm 4	*Both side [buyer-supplier] have really good understanding how we work, so we don't put too much demand on them, and then they understand what impact it would be if they don't produce what they promise and we don't get it. So they understand that well and that's what we require too for our performance (Wholesaler/Retailer).*
	Firm 6	*Anyone wants a new customer vendor, we meet with them, we believe what the term is, what the goal, we always do what we can, visit their facilities and look at their labor ... see everything with them go on right (Processor).*
	Firm 7	*We are having very good understanding among the members …sometimes a bit of friction between the parties … but they can make query if any supply is penalized, a printed report is provided on every product in the supply chain, which is a very good system and important for the business ((processor).*
	Firm 8	*We invite our suppliers, we show them around, show them what we do, show them what are they consist of, so that they have complete understanding, if they are in queue in outside for an hour, or waiting at the dock to unload, they can understand why sometime it takes so long (Supermarket Retailer).*
What do you think about the symmetry in transaction?	***Firm Code***	***Excerpts of data on Symmetry in the relationships***
	Firm 1	*For a successful relationship, the producer and processor have to share in the fluctuation of market … the risk should be shared, so should the price. If I am the processor and I offered you a price, but if the auction market exceeds that price, I will pay you half the difference. If it drops, you pay me half my difference. That's reasonable, common with the approach of some larger companies (Producer).*
	Firm2	*Don't expect the farmers to continually the price takers; they have to share the risk between the two (Producer).*
	Firm 5	*The relationship should emphasize getting highs and lows equally in the market place. It means the farmers or producers, the processors and the feed mills, if they all share the risk of supplying the product that will surely impact on a sustainable performance (Processor).*
	Firm 8	*There is a lot of cost in this side of business what the supplier can't cover sometimes, and for them if they don't have some sort of long term dealings and benefits with someone fairly stable … they may have difficulty (Supermarket Retailer).*

Thus, the findings showed an important aspect of risk sharing; that if the market price exceeds the offered price the buyer should pay half of the difference while if it drops the seller will bear half of the difference. It can simplify the transaction process and work as an incentive, while the insight is greater integration and respect between the members of transaction that may result in more benefits and satisfaction in performance. Otherwise, frustration can arise, as in line as in the following comment:

The difficulty is that farmers in the food industry, being primary producers, are not holding the same status in the supply chain, as the other participants. The retailer has a good relation with the wholesaler. The wholesaler has a great relationship with the processors. The processor has a reasonable working relationship with producers. But in agriculture the retailer would not know about issues if the farmers are failing; they would not know their cost of production (Firm 1 – Meat Producer).

4.3.4.5 Inter-firm relationship

A well-managed supply chain relationship can reduce the risks and uncertainties in transactions and can provide many returns such as: lower product and service costs, improved quality, greater innovation and satisfaction in business performance (Golicic *et al.* 2003). One of the main focuses in the field study was to identify dimensions of relationships that exist in the food industry in Australia and to see how they related to supply chain performance. The study found that agri-food chain relationships in Australia may range from single transactions to complex interdependent relationships, which may vary from arms-length transactions (or market governance) to full vertical integration of the partners based on long-term contract and hybrid cooperative relationships among members (primary producers, manufacturers, wholesalers, retailers etc). The study also found that the degree of relationship can influence supply chain performance. The following factors explain the details.

Strength of relationship

The strength of the supply chain relationship in the agri-food sector depends on how the firms are vertically integrated, share product information and are committed and interdependent to each other. Worldwide, there is a shift from traditional arms-length relationships to the development of long-term partnerships and alliances (Clare *et al.* 2005; Hobbs and Young 2000). From the field study, it was observed that the use of spot market and short-term arms-length relationships are still the dominant mechanisms of transactions in perishable and fresh produce supply chains, such as in vegetables, fruit, and meat products, whereas the grain and dairy industries have more stable relationships based on long-term contracts. The evidence of market relationships based on arms-length transactions is demonstrated from the following three comments from a wholesaler (Firm 4) and retailer (Firm 8):

Basically we deal with the market and also deal directly with the suppliers. As far as a contract goes we do have some direct suppliers contracts (Firm 4 - Wholesaler/Retailer).

We deal with the agent as well, its more taking the advantage of what they got available, its not really long term, as far as the wholesaler or agent, they come in handy for what they got (Firm 4 - Wholesaler/Retailer).

So our basis is a grower base, on top of that we got our central market and brokers on top that … it is customers demand what they want, we are trying to get, if the grower base does not produce what we need then we go to others, we don't close any door anywhere (Firm 8 – Supermarket Retailer).

These comments reveal how processors and retailers deal with their suppliers for sourcing fresh produce such as vegetables. Because of the high demand for quality and freshness, retailers' chains found it useful to maintain open market relationships with multiple suppliers, although their emphasis is on a grower base supply chain.

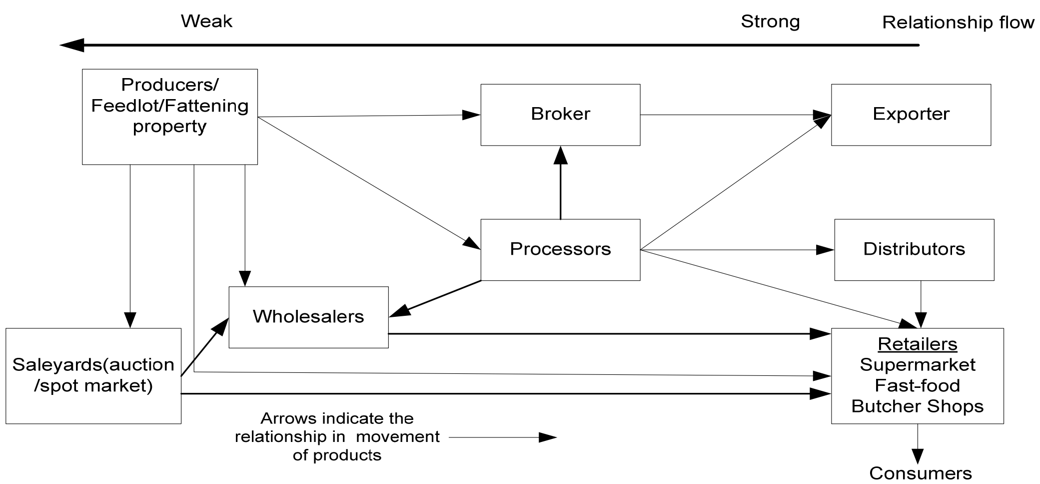
The most important fact is that almost all participants in the study, including retailers, emphasized the development of long-term relationships for mutual benefit. For example, one processor (Firm 6) explained why they were making a long-term contract with one of their logistics partner: *We signed the L….. contract because they like us to stay on board with them for a longer term. They will give us concessions and build a new warehouse in Queensland if the contract is for five years, things like that. So if the contract suits we could sign it for a longer term (Processor).*

The importance of the statement is that a long-term relationship may offer value to both the processing and sourcing firms compared to a short-term relationship that may increase negotiation and enforcement cost in the transaction. The producers at the upstream end of the supply chain also felt that long term integrity with other members of the supply chain is beneficial, as the traditional auction system is putting them in an uncompetitive position and separating them from rest of the chain. The result is a loss of the profit margin when cost of production is going up. As one of the meat producers (Firm1) argued:

At the end of the day we basically have to rely on the long-term integrity of the processors and with other sectors of the supply chain. Where in the auction system there could be one or two buyers buying for 5 or 6 companies, where they will collude to another buyer … will get together and say that if you buy that pan of cattle, I will buy this pan of cattle. This is because of the absence of competition and *therefore the producers are spineless. Because, at the end of the day as producers you can't have, you don't have, any income target (Firm 1 – Meat Producer)*

The frustration is about their sense of isolation from the chain, as the producer continued: *the difficulty is that the farmers in food industry been primary producers do not hold as the same stream of supply chain, as the other participants (Firm 1 – Meat producer).* The notion of the comment is in line with the study of O'Keeffe (1998) where the author reported that in Australian agribusiness, the auction system and regulated market are isolating the farmers from rest of the food system. Likewise, processors and retailers are not having, or not feeling the requirement to develop relationships with growers, although there is an increasing demand for sharing information based on origin, characteristics, processing and handling of the product where the producer's role can be a key part. Based on the findings, Figure 4.5 shows a generic product flow among the members of an Australian agri-food supply chain where the relationships are comparatively weak with upstream producers and are often based on market transactions.

Figure 4.5 Relationship Strength among the Members of Australian Agri-Food Supply Chain



However, during the study some participants expressed the view that producers should change their attitude to understand more about the processors' and retailers' business while the downstream partners should have an obligation to involve producers by encouraging direct communication and feedback by sharing risks and benefits in the chain. One retailer (Firm 8) focused on the importance of understanding and expressed need for long-term dealing with growers as: *We meet* *with them, we believe what the term is, what the goal … there is a lot of cost in this side of business which they cant cover, and for them if they don't have some sort of long-term deal with someone fairly stable … they may have difficulty (Firm 8 - Supermarket Retailer).*

Developing the long-term supply chain relationship may reduce uncertainty in the food chain, reduce transaction costs and provide access to economies of scale, by-passing the traditional market arrangement (Loader 1997). Arms-length adversarial relationships may add monitoring, enforcement and friction costs to the impact of the performance of the supply chain; as one of the producers commented: *We tried to have a good relationship with the buyers, happy buyer happy seller, for a good transaction. But arguing with them and fighting all the time is very difficult (Firm 2 – Vegetables Producer).*

In addition to the long-term dealing, commitment and interdependence in the relationship are good indicators of the strength of the relationship (Clare *et al.* 2005; Monczka *et al.* 1998, Maloni and Benton 2000; Dyer and Chu 2000; Spekman *et al.* 2000). The following statement demonstrates how a retailing firm is committed to its growers:

As far as our dealing with supermarket growers, compared to our brokers or agents, we are committed for payment on time, we pay within 14 days of trading terms, we have a program to order a week in advance, we also give them supply schedule arrangements … which gives them an indication what they can grow to … they know how much they need to grow, they know what orders they are going to get in advance, when it comes to the market, whatever they grow they just send it, and I believe they get something back from us (Firm 8 – Supermarket Retailer).

The importance of the statement lies in how a buyer can develop a close relationship with the suppliers given the effort, commitment, and understanding of each other's business, value and relationship. Another firm commented on how they were generating supply value and managing relationships with suppliers: *We have a different relationship with every supplier … work with each supplier to generate a sales plan … the plan is different, varied to the supplier; there is a strategy, different market strategy for every supplier for every different product. So in terms of the relationship, some relationships are better than others (Firm 4 – Wholesaler/Retailer).*

In the contractual relationship, a lack of commitment may create uncertainty for both the buyer and seller, and may create a hold-up problem in the supply chain. While it is observed that the processors and retailers try to avoid hold-up problems through widening their supply base with many supplier, agent, and wholesaler contracts, the producers face a vulnerable position in cases where the buyer breaks a commitment, e.g., *Last year I held my products six weeks more because the buyer to whom I supply my cattle for 20 years, and who had always been happy with the stock, last year I only got two weeks notice that they had found another supplier from where they will buy and they are not going up to buy from us in line. So I had to hang on a few more weeks until I got on to another abattoir (Firm 3 – Meat Producer).*

The importance of developing an interdependent relationship can also be demonstrated from the above comments; to avoid hold-up problems and to avoid the risk of opportunism. Many studies suggest that successful relationships depend on the extent of interdependence between the partners (Mohr and Spekman 1994) and high bilateral dependence positively influences supply chain performance (Duffy and Fearne 2004). The field study revealed a more considerate and interdependent relationship as well; for example, when a producer fails to meet the requirements, the buying firm is not just switching off to others: *This is not just where we go up for that to switch off. We have a sort of talk, we go through the issues, and we give him [supplier] time to fix it up, it will go down to the due process (Firm 7 – Processor).*

The notion of interdependence can also be shown from the following statement: *We issue a letter or contract as to what we require, how we require it; we will work with them on the freight or transport side, we rely on them to offer our service for sale or they may want to do it by themselves depending on the cost (Firm 8 – Super Market Retailer).* Although it is argued that interdependence is difficult to achieve because of the size imbalance between producers and processors (O'Keffe, 1998), the best way to achieve it is by emphasizing the development of a cooperative exchange where powerful parties work for a greater positive benefit for the whole chain (Duffy and Fearne 2004). For example, extended communication and trust with the growers in a vegetable chain enhance exchange of product information, reduce supply uncertainty, can save monitoring and sorting costs for the buyer, and ensure quality and freshness of product.

Trust

Trust can be a crucial element in the agri-food supply chain due to the fact of growing information demand for product characteristics, some of which may only be analyzed after the consumption of food (experience characteristics), and some may not even be examined at all (credence characteristics). The study findings revealed a low trust buyer-supplier environment in the food chain, as almost all the firms said that they rely on the contract for a smart relationship. The important comments on trust are presented in Table 4.7.

Table 4.7 Findings on the Relationship Issues and Link on Firm Performance

Question	***Firm Code***	***Excerpts of data on Trust***
What is the role of trust in SC?	Firm 2	*Trust is finish. We don't believe in trust …we need contract with the partners to ensure the price (Vegetables Producer).*
	Firm 5	*I think trust is about 50 percent of the right issue, or reckon trust is about 50 percent. Because when it comes about a dollar, things get tight, trust gets out of the door, and in reality, it can't hit the relationship when all the parties share the risk (Processor).*
	Firm 6	*It would not come in handy to have a contract in place, obviously have we ongoing trusted relationship with our growers (Processor).*
	Firm 8	*Majority of the stuffs are written in trading terms. All the legal stuffs are written, all the stuffs relating to money. But then, obviously, you are dealing with these people week to week, their plan and promotions and like that, you don't write everything (supermarket retailer).*
Do you have any joint venture or mutual investment in the relationship?	**Firm Code**	***Excerpts of data on Mutual investment***
	Firm 2	*At the central market sometimes growers and market agents started off market agency … we also invested money with the wash packers (Producer).*
	Firm 3	*We have had investment from the stock agent to improve the quality of feeding when I got beef cattle (producer).*
	Firm 6	*Our relationship with Linfox is extended for a longer term for a mutual investment in building new warehouses and some other facilities…and that works well in improving efficiency of the deliveries of our inbound/outbound goods (processor).*
	Firm 7	*There is investment right throughout the supply chain, it happens in some instances where we might be buying product from a particular farmer, we invest to make sure he got the right instruments (Processor).*
	Firm 8	*We do have investment with the producers when we get new lines, new fridge or new vegetables come on board (Supermarket Retailer)*

It was found that the growers' perception of trust on its transaction partner is lower than the perception of the processing and retailing firm, which is evident by: *Trust is* *finish. We don't believe in trust …we need contract with the partners to ensure the price (Firm 2 – Vegetables Producer).* The processing firms commented more substantially: *It would not come in handy to have a contract in place, obviously have we ongoing trusted relationship with our growers* (Firm 6 – Processor). However, the retailers found an indirect role of trust in their day-to-day dealings and performance, but still focused on written terms and regulations to conduct monetary transactions.

Mutual Investment

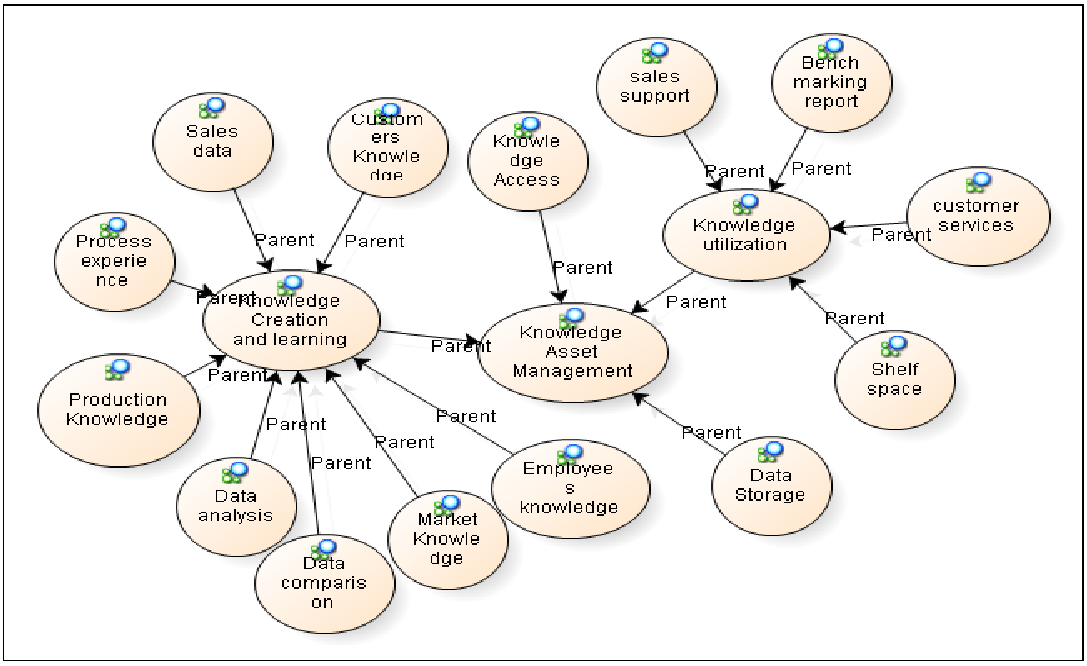
The nature of the agri-food companies requires that they should make some investment to close the ties with their primary producers for ensuring raw inputs; for example, investment for animals, feed and management services for a cattle firm. Sometimes investment to gain the confidence of buyers is also worthy; for example, investments in equipment such as a cooling van to transport products from suppliers to retailer's shops or technologies to improve food quality and safety may have a significant impact on the relationship. Studies have noted that investments can make buyer-seller relationships closer and enhance business transactions (Lu *et al.* 2006).

Evidence also comes from the findings, as displayed in Table 4.7**,** that investment right through the supply chain improves its efficiency and performance. Firms are making mutual investment by catering to the special needs between primary producers and processors, producers and market agents, or producers and retailers, which are important sources of value creation in inter-firm transaction. Firms are also investing in relation specific assets to have a long-term relationship; for example, Firm 6 stated that: *Our relationship with L…… is extended for a longer term for a mutual investment in building new warehouses and some other facilities … and that works well in improving efficiency of the deliveries of our inbound/outbound goods.* Other firms expressed the view that they are investing together when they wish to develop new products, or investing in feed to ensure the quality of the products.

4.3.4.6 Knowledge asset and firm performance

It has been argued that knowledge asset management in an agribusiness supply chain can contribute to procurement, production and distribution mechanisms that elevate the chain as an important competitive weapon to gain better firm performance (Ketchen and Hult 2007; Lin *et al.* 2002). However, knowledge assets in a supply chain can be a resource, a competence and a capability; they can be diverse as areas of experience and knowledge on raw materials, consumer requirements, manufacturing, sourcing, marketing and all the associated systems and software. As the focus of the field study is on the Australian food industries, it was important to know how companies were developing new knowledge in the processes of their supply chain, sharing it across the chain members and utilizing it for increasing firm performance. Figure 4.6 as derived from the content analysis using NVivo 8, shows the important factors and variables in the knowledge creation and utilization processes in the food industry supply chain that also impact on firm-level performance. These factors and their associated impact on firm performance are discussed below:

Figure 4.6 Key Factors and Variables in Knowledge Creation and Utilization Process



Knowledge creation and learning

Bogner and Bansal (2007) argued that sustained firm performance is related to well-developed capabilities which can be gained by: i) developing either high impact or incremental new knowledge; (ii) using existing, internally developed knowledge as an input to build subsequent new knowledge; and (iii) appropriating long-term benefits from inventions, by developing subsequent inventions**.** The result of the current multi-case qualitative study indicates that companies used different sources for learning and creating new knowledge to have an immense affect on their efficiency in managing the whole chain. For example: *We keep all the sales data, because sales are where we make our money and sales are the size of the business which we always monitor and look onto it … it can tell us what's going on the market place at the moment today (Firm 1 – Meat Producer).* Firm 4 said: *We need to keep our eyes everyday especially on sales data to know how we are going. Because it affects everything down the lines, logistics and manufacturing supply chain and purchasing of the raw materials (Wholesaler/Retailer).*

The importance of the above two comments is very significant as they illustrate how internal knowledge generated from sales and customer data impact through the whole chain. The comments focus on learning from the sales data that affect everything from growing and supplying of the raw materials down the line of logistics, manufacturing, and marketing of the products. Table 4.8 summarizes the findings on knowledge creation and learning factor.

Table 4.8 Findings on Knowledge Creation and Learning

Question	***Firm Code***	***Excerpts of data on knowledge creation and learning***
How does your firm create or collect SC Knowledge?	*Firm 1*	*We keep all the sales data, because sales are where we make our money and sales are the size of the business which we always monitor and look onto it … it can tell us what's going on the market place at the moment today (Producer).*
	Firm 3	*We employed companies to do survey for us. We get company to do that for all important facts about our customers, the competitors etc. and we react to the survey that comes back to us (Producer)*
	Firm 4	*We need to keep our eyes everyday especially on sales data to know how we are going. Because it affects everything down the lines, logistics and manufacturing supply chain and purchasing of the raw materials (Wholesaler and Retailer)*
	Firm 6	*We have an 'Apollo Analyze' team. Their job is to look at the layer at the supermarket and they look at all the products in the biscuits aisle, competitor's products, our product, home brand products; we get data on all of that (Processor).*
	Firm 7	*I think we are smart enough as a business to choose partners, when they give us a presentation but we don't just take it, as talk is cheap, so we just always look on facts and says its ok, or it sounds great, then we start talking to other people, who have a portfolio with them about what they think of the company, which is most important (Processor).*
	Firm 8	*We do surveys in our own distribution centre, about our supermarkets and about our own staffs. We do that every year (Supermarket Retailer).*

It is important to note the comment of Firm 6 in Table 4.8. They have a group of people to collect data on their competitors' products from the market and from retailers' stores, and then analyze the data to generate valuable input to keep their products at a high level, whereas Firm 3 and Firm 8 use survey to collect data and other important facts on their customers, staff, and distribution channel, in addition to keeping and analyzing the sales data. They analyze data to generate knowledge, then transfer and share it with their partners in the supply chain for improving competitiveness and performance. From the interview data it was found also that farmers and producers are relying on market knowledge, specifically for the use of fertilizer, grain, feeding and the quality and pricing of their product. When involved in inter-organizational relationships, mostly they get feedback from their downstream partners, but still a majority of the farmers gain knowledge from the spot market transaction, from their experience of managing, and also from various electronic and printed sources that come through internet, government publications and so on.

One important insight identified from the study, as two of the firms mentioned, was that they learn from their colleagues, such as by organizing discussions and meetings to review the supply chain performance and receive weekly emails from their bosses about ongoing issues, which enhance knowledge and promote a learning environment in the chain. One comment about seeking a new partner was that: *I think we are smart enough as a business to choose a partner, when they give us a presentation but we don't just take it, as talk is cheap, so we just always look on facts and says its ok or it sounds great, then we start talking to other people who have portfolio with them, about what they think of the company, which is most important (Firm 7 – Processor).*

Knowledge memory

In respect to firms' initiatives in achieving and storing knowledge, it was identified that all processing and retailing firms used an electronic system to capture, codify and store related data and information, and then analyze it to generate knowledge. The retailer's concern is about the high volume of data being produced everyday and pushing them to use some of the advanced warehousing system. For example: *We all have our internal systems to keep information about our customers, delivery dates, all that internal, all automatic … stores transmit order to us, electronically that* *comes in, get batched to the relevant order date, put it in the peak cycle stock, its all automatic, driven by the information in the system (Firm 4 – Wholesaler/Retailer). Firm* 8 said: *We have system to collect those data. We outsource and contract it to some company to analyze our data. We can see in the system what demand is for the products … so we know what the customers want, or those what they don't want, both from the satisfaction side.*

The comments revealed that processing and retailing firms are maintaining data warehouses to contain and track internal data, domain and sales data; mostly they outsource the task to other companies. The study also revealed that, although the producing firms are lagging behind in use of advanced electronic systems, they can use Internet or other central feedback systems from the producers' association to track inter-firm transaction issues in the supply chain; e.g., the price, productivity and the market trend of their products.

Knowledge access and sharing

The study revealed that the access to knowledge and sharing it with other members of supply chain requires agreements and compatible tools/technologies between the firms. All firms that use knowledge systems use advanced technologies to get the scanned data back to their system from the partner's point of sales. These systems are able to analyze the data to produce reports that are of common interest for sharing among the supply chain partners. Table 4.9 presents the issues related to the accessing and sharing of data, as found in the current study.

Table 4.9 Findings on Knowledge Access and Sharing

Question	*Firm Code*	*Excerpts of data on Accessing and sharing supply chain Knowledge*
	Firm 2	*We receive benchmarking report from our mighty customers, for comparing the data with others (Producer).*
How is your firm getting access to or sharing SC knowledge with your SC partners?	*Firm 4*	*There is always store manager who gets SMS, saying your loads are coming up at 5.00 pm today, it will be ten pallets, so the store can get ready, get their team ready to get that loads, they can check and track their orders on the Internet, there is a web based tracking of orders and stocks (Wholesaler/Retailer).*
	Firm 5	*We do actually have access to some store, but in most stores we don't, we are doing it now, which is a project of the last year to initiate pulling back the scanned data and analyze that as well (Processor).*
	Firm 6	*We are implementing technologies to be able to see what's actually scanning at the sales, currently we only know about the sales of some stores from the warehouse, because we track all that (Processor).*
	Firm 7	*We need to ask them to get access to these data, they are independent businesses, it's a negotiable speech with businesses to ask for the data back, and obviously we can't use that data unless you say why we are going for that (Processor).*
	Firm 8	*We use our own in-house system to access and share supply chain knowledge. The system shows us what stocks are coming across … we receive that order by our web system (Supermarket Retailer).*

The comments demonstrate how knowledge sharing in the supply chain depends on the accessibility and compatibility of technologies between firms. Companies are implementing electronic systems to be able to access to other companies' transactions and generate knowledge from transactions data that could guide them for further improvement or keeping up standards in the chain

Knowledge usage and value realization

Evidence from the study demonstrates that firm performance depends on gathering knowledge on market trends and the downstream customer requirements and sharing and utilizing the knowledge upstream for growing, developing and manufacturing a product with the targeted quality and cost**.** This phenomenon is known as 'Industrialization of Agriculture' (IA), where the decision is made to change from the beginning of a supply chain based on downstream knowledge of customers, their requirements and needs (Soucie 1997). Similarly, a supply chain that uses knowledge derived from key customers and sales data will help chain members reduce the so-called 'bullwhip' or 'whiplash' effect, a phenomenon of demand distortion. The inference of the statements above has come from the evidence of the comments presented in Table 4.10. For example: *Our mighty customers create benchmarking report for us, so that we can track how our farm is doing. We can see how we are competing with other firms. Whether our sales are tracking well, or if there is something what we are not doing but the other farm is doing (Firm 2 – Producer).*

Table 4.10 Findings on Knowledge application and value realization

Question	*Firm Code*	*Excerpts of data on Knowledge Application and Value Realization*
How is your firm utilizing SC Knowledge and improving your firm performance?	*Firm 2*	*Our mighty customers create benchmarking report for us, so that we can track how our farm is doing,. We can see how we are competing with other firms. Whether our sales are tracking well, or if there is something what we are not doing but the other farm is doing (Producer).*
	Firm 4	*When we order a product, its all just get together from the system, although stock manager review it for any change. Our ordering system suggests what we need to order. The stock control manager reviews that, and makes the final decision such as yes I need a hundred cartons of that (Wholesaler and Retailer).*
	Firm 5	*A lot of work done behind the scene before we choose our partner, we first know about reputation of the company, and also their profile, and portfolios with whom the companies have on their portfolios at the time, and we probably speak to these companies what they think about certain companies doing as a service to them, so there is a lot of research done behind the scene to decide to contract a different transport company (Processor).*
	Firm 6	*We use data we get from our major customers … what best customers use our products, have the best display or stock throughout the year. Analyze it quite a few times, and then talk with the retailers. We have a say where on their shelves we can put our products when they put others (Processor).*
	Firm 7	*We do judge our competitors whether we are doing well. With the data we got … we know what we have sold in a customer's store over the last six months and deal with that customer for further business, for example, this product was the most popular product ticket sold in the last six month, so it needs to get more facing to increase sales in the store. They may do that or may face the risk of loosing some sales and loosing the opportunity in growing business with us ... So it [knowledge] helps us deal our buyers (Processor).*
	Firm 8	*From the system we draw our demand forecast. First, we get a minimum of two weeks forecast what we think we will need, then we do a three day forecast, just before three days we need the stock, and we are pretty accurate of getting on what's required (Supermarket Retailer).*

The first comment demonstrates how firms are using benchmarking reports to judge their standards with the competitors, while Firm 8 reduces its inventory and ordering lead times by combining knowledge from the system and from the buyer-supplier transactions, and by sourcing their required stock sometimes with only three days lead time. Most processors and retailers are using knowledge systems that accurately can forecast the demand based on sales data, but, there is always a stock controller who applies the supply chain knowledge to combine and finalize the recommended order from the system.

However, one of the interesting facts identified from the study was that Firms 6 and 7 mentioned how they use knowledge, generated from the sales and competitors' data to bargain with the largest customers, such as with a supermarket retailer for gaining more shelf space in the retailers' store. For example, Firm 6 stated: *We use data that we get from our major customers ... what best customers use our products, have the best display or stock throughout the year. Analyze it quite a few times, and then talk with the retailers. We have a say where on their shelves we can put our products when they put others.*

The statement of Firm 7 shows the power of knowledge to conduct business with the largest chain partners such as with a supermarket retailer. The evidence showed that processing companies can keep their product at a high level by analyzing the sales data, reviewing the information on yearly stock order and display level at the retailing partners' stores, and then bargaining with the retailer to gain more shelf space and convenient placement at the stores. The companies said that they get the scanned data back from their customers and analyze them quite a few times to know how their sales are going, the level of their inbound service and how their market share was growing. Finally, while discussing how access to knowledge is helping these companies to choose their partners, Firm 5 demonstrated their experience of choosing a logistic partner as mentioned in Table 4.10.

4.3.4.7 Use of Inter-Organizational System (IOS)

The push to lower the cost through supply chain results many cutting-edge IOS technologies in the supply chain practices of Australian agri-food companies. The systems vary from using traditional EDI to radio tracking, and automatic stock controlling systems involving one touch rolling units for the distribution of products from manufacturers' facilities to the retailers' filling of shelves. During the field study, all the participating processing and retailing firms and one of the producing firms explained that they were using IOS systems that put them one step ahead of their competitors. The important findings are displayed in table 4.11.

Table 4.11 Findings on the use of IOS and its impact in firm performance

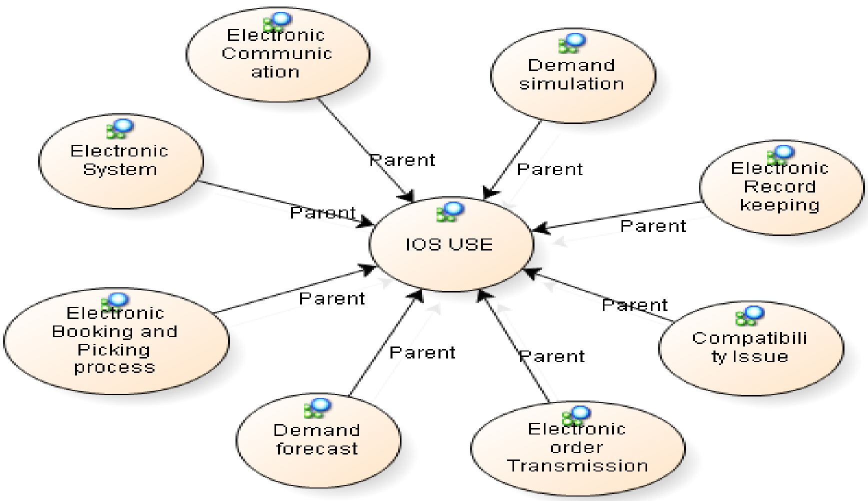
Question	*Firm Code*	*Excerpts of data on IOS usage*
Are you using any electronic system for maintaining inter-organizational relationship in supply chain?	Firm 1	*We put radio frequency chips in our products (Producer)*
	Firm 4	*From transport to store, store receives automatic SMS, when the load needs to be delivered, whether it is delayed, so that they can manage this stuff around those loads (Wholesaler/Retailer).*
	Firm 6	*The ordering system starts from the customers, and goes through our system in Sydney. We use EDI system and the orders come down to us at a site level in a different in-house computer management system that we use (Processor).*
	Firm 7	We *are using EDI, ready to use a long ago, when there were not handful supplies to use EDI components (Processor).*
	Firm 8	*We use our own in-house system that shows us that the stock coming across... So we get booked electronically, we get store away electronically, get transferred and picked process electronically. There is no manual system that we use any more for in coming or out coming goods. It's all computerized system that we do use to be more accurate and efficient (Supermarket Retailer).*
Is there any issue your firm is facing?	**Firm Code**	***Excerpts data on compatibility issues***
	Firm 4	*We have individual franchise agreement with these customers that we dealt with, and they run different system on store and they got compatibility issues (Wholesaler/Retailer).*
	Firm 6	*We need to deal with many different types of systems in stores, install software for compatibility issues and also get an agreement to supply the data back (Processor).*
	Firm 8	*We got that issue with make cash in WA at the moment. Because we have only just started going to make cash with central warehouse … then we found out that our EDI system is not compatible, so we will be needed to upgrade ours to make align with make cash in WA. It's a national issue we have Australia wide (Supermarket Retailer).*
How is it impacting your firm performance?	**Firm Code**	***Excerpts of data on IOS impact on firm performance***
	Firm 1	*It is good for visibility (RFID) and for the product movability. When we sell them with the year mark, we may also know where the product is (Producer).*
	Firm 4	*The benefit is far greater with it than without it. Again for the speed, because we want to communicate with our vendors and customers as quickly as possible … It's all done by the system, on the system when it is ordered through, for example if we got a delivery and its not what it should be, we contact with them, discuss with them … So it works really well for us (Wholesaler/Retailer).*
	Firm 6	*The IOS system put us one step ahead than our competitors (Processor).*

	Firm 8	*Just from a system perspective it's fantastic. It's also safe for the store level. We used to have a back store room before, you know those supermarket's stock rooms are very big. They used to be just full of everything, because it was not an accurate inventory. With the Auto stock R, now you can walk into the supermarket stock room, and its fairly clear, its not bad as it is to walk through but three or four years ago you could not walk through them in Christmas (supermarket retailer).*

IOS usage

As shown in Figure 4.7, the field study identified some important uses of IOS in the supply chain; uses which impact on supply chain knowledge transfer and on firm performance.

Figure 4.7 IOS Use in Supply Chain and Firm Performance



It was found that the use of IOS depends on the underlying inter-firm relationship. As different types of relationship require different information and knowledge requirements, IOS offers to achieve the functionalities within the context of buyer-supplier relationships. For example, in an arm's-length transaction, pre-transaction knowledge on market standards and alternative sources are really high; whereas, in a partnership, knowledge on process synchronizations and adaptation are relatively high (Saeed *et al.* 2005). The current field study revealed that IOS can enable firms to establish many linkages to gather that knowledge and provide the best available options in transactions; they can support tightly coupled processes between firms by exchanging precise and timely information. This may enable production scheduling aligned with the forecasted orders from the customers. For example, Firm 4 said:

From transport to store, store receives automatic SMS, when the load needs to be delivered, whether it is delayed, so that they can manage this stuff around those loads (Wholesaler/Retailer). Company 6 said: *The ordering system starts from the customers, and goes through our system in Sydney. We use EDI system and the orders come down to us at a site level in a different in-house computer management system that we use (Processor).*

Insight from the statements lies in how knowledge tools and capabilities enhance knowledge transfer by enabling a firm to communicate and coordinate the processes of inter-firm transactions with precise and accurate information on production, orders, loading, delivering and receiving the products. The comments also highlight important insights about lowering costs through accurate inventory, reducing lead times and increasing visibility, reliability and responsiveness in manufacturing in order to deliver products. Discussion with the companies revealed that, for perishable products, retail firms always look for quality and freshness; and by using IOS they can work closely with their suppliers, communicate and coordinate with them with the orders needed, sometimes with only three days notice and lead time to fulfill the demand. Processors use EDI to accumulate the customers' orders, coordinate the raw materials suppliers, manage the production and, finally, distribute the products to retailers. However, data from the study revealed another important aspect of the supply chain that most farmers involved in fresh produce are significantly behind in using any EDI technology; they have only just started using computers and email, though it increases the communication and monitoring costs in the supply chain as one retailer commented, *Local growers, a lot of them in the Fresh food chain, they own family business. They don't use EDI technologies … it adds cost to the supply chain, and that's cost to our customers (Firm 4 – Wholesaler/Retailer)*

Compatibility Issue

During the study, it was found that compatibility of using IOS is an important issue in a supply chain; one which sometimes creates obstacles in developing the knowledge chain. Firms using IOS face compatibility issues as demonstrated by Firm 4: *We have individual franchise agreement with these customers that we dealt with, and they run different system on store and they got compatibility issues*

(Wholesaler/Retailer). Firm 6 said about the same experience: *We need to deal with many different types of systems in stores, install software for compatibility issues and also get an agreement to supply the data back.*

Companies having the issues with their customers as well as with their suppliers need to be EDI compliant, such as system upgrades, software installations and agreement for getting the sales data back. An important fact found in the study is that larger market shares generate power in relationships; therefore firms may feel obliged to become EDI compliant with the powerful party that incurs costs for investment and making agreements in the relationship. For example: *EDI system is obviously the most preferable system to use which we do use and which our competitors as well. Our customers also have to invest to become compatible with our system (Firm 6 – Processor).*

4.3.4.8 Uncertainty in the agri-food chain

Uncertainty in the supply chain refers to a situation in which the decision maker is unable to predict the accuracy of control actions either for a lack of information and imperfect knowledge in supply chain or for a lack of effective control actions (Van derVorst and Beulens 2002). Uncertainty may increase the transaction costs (Hobbs 2000) and can negatively influence the partnership (VanderVorst and Beulens 2002) and supply chain performance (Davis 1993; Lee *et al.* 2002; Patrovic *et al*. 1998). Researchers argued that strong relationships with key suppliers and customers may reduce uncertainty and minimize risk in the supply chain (Handfield and Nichols, 1999). The current field study revealed that uncertainties influence the Australian agri-food chain and eventually impact on the contractual arrangement, the degree of inter-firm relationship and supply chain performance.

Demand uncertainty

There is a lack of methods available to handle uncertainty when demand is sporadic (Bartezzaghi *et al.* 1999). Uncertainty of demand contributes to a lack of ability in being able to specify all contingencies; evidence of this statement coming from the following three comments:

At a certain time of the year when we need that stock, or we want plenty of it for a Christmas party or Easter party, we face risks because we have a huge demand but do not have enough supply (Firm 8 – Retailer).

We see what we can do compared to our competitors depending on the volume of demand, and the assignment of the year. I mean Australia has typical weather, you got drought one year, and you got short supply in the following year and the price goes up, Cyclone took the bananas two years ago and the bananas were priced six or seven time higher than they should be (Firm 4 – Wholesaler/Retailer).

So with the farmers and growers, the issue is about the demand, we say that we will definitely take this amount this week, which is not exactly there because of the market at the moment, as we are not sure what they actually sell because of the inflation of that product at the moment … it is the farmers who will struggle, its all logistics partners in the market who struggle (Firm 6 – Processor).

The above statements demonstrate that firms sometimes are unable to specify all the contingencies in predicting demand because of the seasonality and variable weather in the food chain. Some processing and retailing firms explained that most of the time they accurately forecast the demand simulating it from the inventory system but at certain times of the year for certain types of products, they end up with too much stock or were out of stock. Both cases affect the industry negatively.

Supply uncertainty

Usually uncertainty in supply revolves around the supplier side and can impact on the performance of the supply chain. Uncertainty also arises on the buyer's side when the reliability (timeliness and quantity) and quality of the products are critical (Hobbs and Young, 2000). Five out of the eight participants from the field study expressed their concern about supply uncertainty, saying that it was one of their biggest problems in the supply chain. The following four comments demonstrate the point:

The biggest problem is that this train line probably de-rails between 5 to 15 times in a year which stops supply of 80 percent of goods … so what we may find is that a 3 day train derailment probably results in service level disruption in perishable, going from 96 percent down to a low of 80 percent (Firm 4 – Wholesaler/Retailer).

It may comes with the factory break down, or any of the risks that are associated with the manufacturing … it is really on the supplier side. If their machinery breaks down, if they have a capacity problem, which may take them a year to increase the capacity or their warehouse, these are the problems that we face (Firm 6 - Processor).

The biggest risk of all is the supply of grains. Grain for feed is 60 percent of firm costs. Last year, grain prices had gone from $300 to $450 within 6 months; a massive jump, therefore, for every $10 increase, costs rise up to 5 cents a kilo (Firm 3 - Meat Producer).

For train derailments or any other supply problem we talk with all our stores about getting our product in late, the product coming out of code and things like that which add extra cost at the service level. Sometimes, in some cases we get products on our shelves with more cost than they are worth because of those circumstances (Firm 8 - Retailer).

The above statements illustrate how uncertainty of supply can be a major problem for the firms, causing service disruption at the production and store levels. WA retailers said their biggest supply problem was train derailments in getting the products from the eastern states. They cause perishable products to go out of code and in some cases the products were lost completely. Also retailers cannot handle excess inventory for perishable goods that have a limited shelf life. Thus, trains derailments result in supply and service level disruption and extra costs that, ultimately, are passed on to the customers. Producers and farmers have uncertainty in the supply of grain and fertilizer, which costs almost 60 percent of their production. Any uncertainty or increase in grain price results in significant disruption of the farmers' production. Therefore, some firms' emphasize the enhancing of relationships with their partners and an integrated supply and warehousing system in the chain so that risks will be shared by all the parties involved; they focus on establishing a stable supply base aligned with the manufacturing process with highly automated systems and long-term supply contracts for a greater performance.

Price Uncertainty

Traditionally in buyer-seller relationships, both parties face price uncertainty which impacts on the performance of the supply chain (Hobbs and Young 2000). During the field study, almost all participant firms expressed their concern about price uncertainty as evident in the following comments:

We pick a price for them [supplier] in a week advance …but risks in the market are basically just day-by-day. You sent an order and hope what you said they will get it … but when you see too many cauliflowers up on the market today, the price goes down, so what we have negotiated for the whole week, there is no where now we can stand (Firm 8 – Retailer).

There is a risk of the grading system because if we are out of it, we may not get any money. So if I try to double my production using technology, and if it don't work or somehow I lose my grade, I may lose my price and may be sold out. So that's the risk when we don't have a good contract (Firm 3 - Meat Producer).

We don't specify price in the contract, we only talk about the numbers. The contract is only a supply schedule arrangement (Firm 7 - Processor).

Uncertainty over price is our biggest factor. Because you got no control on it … when we are getting a price improvement over a period of six or seven years, our cost of production is almost the same by that time. So what we are getting, there is no way we can sustain on it (Firm 2 – Vegetables Producer).

I can produce beef, twelve months in a year; my cost of production allows me a profit, given climate, given things out of my control for about seven months of the year. Now if I was paid enough to subsidize my extra costs of producing a product out of season, I would then be able to do that (Firm 1 - Meat Producer).

It is evident from the above statements that firms are facing uncertain prices not only because of the relative demand and supply position in the market, but also because of the existing system in the food chain where upstream industries, specifically the producers, are not able to extract a better contract for a better price of their products. Some firms also reported that their returns from the business are even lower than their cost of production and that makes it difficult to sustain the business. However, three participants talked about sharing the risks and strengthening the relationship as a mechanism of dealing with the cost structure and profitability.

For a successful relationship, the producer and processor have to share in the fluctuation of market … the risk should be shared, so should the price. If I am the processor and I offer you a price, but if the auction market exceeds that price, I will pay you half the difference. If it drops, you pay me half my difference. That's reasonable, common with the approach of some larger firms (Firm 1 – Meat Producer).

We need to look at the ways we can be much more innovative in the industry and how we can work much more cohesively throughout the supply chain where the risk is shared by all the parties … the farmers or producers, the processors and the feed mills, if they all share the risk of supplying a product that will simplify the process (Firm 5 - Processor).

Don't expect the farmers to continually be the price takers; they have to share the risk between the two (Firm 2 – Vegetables Producer).

Input availability

Uncertainty about getting input for the production is inherent in the processes of the supply chain. While the quantity and quality of getting raw materials in time is the biggest performance issue in supply chain, it may increase the risk of transaction costs and viability of the chain partners. Evidence of this statement is found from the field study, where Firms 6, 2, and 3 have spoken about how input to production may affect their business; below are some examples:

Over the past four years it [the business] was not going in the direction we wanted to, due to a lot of issues out of our control, potato shortage, potato price, the availability of potatoes, and the raw materials we used just did not work out the way we could make profit (Firm 6 – Processor).

Risk of product once again is in the supply of raw materials … if there is a matter of contamination or flours dents are not good, or the quality of the flours is not up to expectation, then we have to reject that. So that's an ongoing risk. We have a large department for quality, to check the quality of raw materials and be sure that they are up to our standard (Firm 6 – Processor).

[the processor] could not get the growers' support to keep the production volume up. So the growers wanted more and more money and they failed (Firm 2 – Vegetables Grower).

I could stay a lot better. A lot about the input, we could do that. But we are just cutting costs, we are cutting them and we don't know whether that line is crossing the cost that you can't sustain (Firm 3 - Meat Producer).

The above statements indicate how the availability of inputs causes high production cost and less volume of production that affect the business negatively. In the absence of a trusted relationship, the quality of raw material can be a big concern as it increases the cost of sorting and monitoring the product. One participant (Firm 6) sold part of their business as it was not viable due to the shortage and uncertainty of raw materials. Given the high cost of inputs, but a very marginal market price, Firm 3 was trading off the quality and cutting the cost of inputs to a level that they feared was not viable. Therefore, the study revealed a direct influence of input uncertainty on the performance of the supply chain.

Product perishability

Product perishability creates uncertainty for both buying and selling firms because of the risk of losing quality and not meeting the time code of products. The producer, processor or selling firm may need to move to the marketplace quickly because of the deteriorating quality of the product with a shorter shelf life. Consequently the seller faces uncertainty in finding a buyer and may lose out on the price. The following comments from Firms 2 and 4 in the field study demonstrate the point:

As growers we have to market to our buyers. We produce the right variety in the right quantities they want … deliver on the right days, but even then they don't always take them. Then you know, we can't keep those products for long, we get few days to sell those because we lose the freshness (Firm 2 - Meat Producer)

In grocery we carry more stock, as much as we like … [but] for perishable you cannot do that because you simply cannot hold a lot of stock because they will be out of code. A yogurt that may be produced for 28 days code on it, and that's fine in Melbourne and Sydney but by the time it gets to us [Perth], it has 22 days code on it (Firm 4 -Wholesaler and Retailer).

If I produce a hundred tones of potatoes then I might have six customers to sell to … but if something happens with the wash packer's contracts and if there is no buyer, he cannot tell me that he does not want the potatoes … that's very difficult and that's why you need a good relationship (Firm 2 - Vegetables Producer).

These comments demonstrate how producers and retailers face uncertainty in the marketplace. Because of the nature of products, producers and retailers usually have only a few days to sell in order to avoid losing the quality, grade or the code of expiry of the products. Most of them are unable to store stocks for the longer term and cannot wait for favorable market conditions to occur. Hobbs and Young (2000) found that product perishability creates uncertainty for the buyer in terms of quality and reliability of supply, and increases transaction costs such as sorting cost to determine the true quality of the product (Barzel 1982). The following statement from Firm 8 indicates support for the earlier findings.

We basically require a certain quality in the fresh product, so our guys go out there and they look at it and say yes it is what they want, we will then order … we got our own quarantine inspection … where we test the product … measured or whatever is needed. So basically we look at every product based on a fresh perspective that it is what it supposed to be, and then our people consult with the growers, buy it or contract with the growers, or vice a versa, to keep our relationship going (Firm 8 - Supermarket Retailer).

4.3.4.9 Achieving competitiveness through supply chain performance

An important factor that was identified in the field study was the linking across the supply chain to generate competitiveness. While the studies of Porter (1985) and Fearne (2008) focused on improving the activities of the value chain to gain competitive advantage, many studies (Proactive communication 1996; Lee 2002; Ketchen and Hult 2007) have argued that performance improvement in the supply chain offers competitive advantage for firm performance. Evidence from the current field study also revealed that three key points of competitiveness, viz., cost efficiency, innovation and strategy, stem from the performance of supply chain, as explained below.

Cost efficiency

Cost efficiency is one of the most highlighted challenges in firms; increasingly they emphasize rapid delivery service performance, reducing distribution steps and lead times together with a highly effective logistic system for gaining competitiveness by meeting customers' demands with the availability (product) and convenience (cost and time) they want (Proactive communication, 1996; Lee, 2002). As a result, the supply chain performance of agri-food industries, with their association with perishability and high uncertainty of supply and demand, is critical in gaining competitiveness. The evidence of this statement is strongly demonstrated by the following two comments from Firms 4 and 6:

We are always looking for efficiency, we have a logistics division for ensuring the efficiency in order, loads and quantity… load of full trucks or full container to order by the time, then in the warehouse we are always looking at improving efficiency, the way we handle … to reduce our costs, to reduce our customers' costs, to reduce time, more productivity, things like that … So like others, Woolies and Coles we are constantly looking for efficiency and competitiveness (Firm 4 – Wholesaler/Retailer).

To be more competitive we have to have a larger market share in the business. For us to do that we need to ensure that we can get the orders delivered in full. Sometime we struggle to make us more competitive in that, sometime we fall down … now we are concentrating very hard on what the customers orders and what we get. If we can't fulfill the demand it will make us very hard to be competitive (Firm 6 - Processor).

These comments demonstrate examples of gaining competitiveness through supply chain performance. The retailers' priority in the first statement is to commencing the ordering activities on time, ensuring a full container load for transportation and increasing efficiency in warehousing and delivering to ensure cost effectiveness and competitiveness, whereas the processing firms focus on increasing process efficiency and the satisfaction of customers by delivering orders on time. In both cases, processing and retailing firms emphasize the efficiency of fulfilling supply and demand to achieve significant cost competitiveness.

Innovation

Dyer and Sing (1998) argued that partnerships or alliances in the supply chain may generate competitive advantage when there are unique resources, specific investments and substantial exchanges of knowledge between the partners. In line with that argument Fearne (2008) showed that strong relationships and information flows in the food chain may increase collaboration for co-innovation among the chain members. In the current field study, the evidence of co-innovation and competitiveness through the relationship and knowledge exchange in the supply chain was demonstrated in the following comments of a wholesaler and a processor:

We send them benchmarking data, for comparing the data with other stores, and sending it back anonymously, so they can see how they are going compete with others, whether their sales are tracking well. That's the value we can give them by analyzing the sales data. We create a benchmarking report for them so they can track how they are doing or if there is other store doing well than them (Firm 4 – Wholesaler/Retailer).

We judge our competitors whether we are doing well. With the data we got … we know what we have sold in a customer's store over the last six months and deal with that customer for further business, for example, this product was the most popular product ticket sold in the last six month, so it needs to get more shelf space in the store. They may do that or may face the risk of losing some sales and losing the opportunity in growing business with us. So it helps us dealing our buyers (Firm 6 – Processor).

In the first instance, the comments display the importance of creating benchmarking reports from internal sales data and sharing it among the independent stores to help increase competitiveness. In the second instance, a processor was sharing innovative ideas with retailers, using the knowledge on their popular products to increase sales and profits by using more shelf space than their competitors. However, another key finding is that price stability for upstream producers can ensure productivity, innovation and economies of scale in the industry, as evident from the following comments from two producers in the meat industry:

There is so much more that the firms can do but at the end of the day if we haven't got the margins to invest back in the industry, our productivity will not increase and the cost of production will only go higher (Firm 1 - Meat Producer).

To be efficient we need price, an increasing price of our product … We can almost double our productivity if we want to, but there is no money in building it, and there is no one helping to build it, then we actually reduce the productivity. (Firm 3 - Meat Producer)

We will produce any agricultural products for twelve months of the year. We can make it possible. Some products you can't just do it for 12 months, we will extend that season so that we can produce low cost agricultural product in our local areas, if we are paid enough … if I was paid for the extra cost of producing out of season I will do that, but if I don't, I am not going to do it (Firm 1- Meat Producer).

Strategy

The current study also revealed that the participants, from the upstream to downstream industries, have their own competitive and marketing strategy to keep them viable in the business; for example, the following two comments demonstrate how companies are developing competitive strategies and growing their market share in the presence of strong competitor brand from the largest retailers:

There is a lot of data on consumers buying the cheapest products … this is one of our major challenges, if we had few challenges in our businesses that is one of them, is to ensure that we are beating the competitors, keeping our product at a high level in quality and standards, so that they buy it" (Firm 6 – Processor).

Similarly, wholesalers and retailers are depending on the strategic relationship in the supply chain to develop market strategy and increase competitiveness.

Make-cash is in every state of Australia and the market is different in every state. So we will adapt with sales, will work with each supplier to generate a sales plan for that state … the plan is varied to meet the supplier; this is strategy, different market strategy for every supplier for every different product. That's why some relationships are better than other others, as in any business (Firm 4 – Wholesaler/Retailer).

Therefore, competitive strategy may come from the relationship strength in the supply chain that allows variation from suppliers to suppliers depending on mutual interest, understanding and goal. The current study also noted evidence that producers are diversifying their products and developing alternative marketing strategies to increase their productivity and competitiveness in the food chain. When asked about the farmers' strategy in growing market share, one vegetable producer focused on developing a cooperative farmers' market rather than relying on the supermarket; for example: *we can grow market now, taking business away from supermarket. It's a bit cheaper, a bit fresher. There will always be shoppers who go to the super market. But more concerned buyers will go to those markets [Farmers' Market] (Firm 2 – Vegetables Grower).* However, another participant focused on the importance of product diversification to increase viability in the chain.

In WA a mixed firm may have wheat or grain operations, or sheep production, or might have beef-sheep productions. They generally either have sheep, beef and grains, or grain, pigs and sheep, or grains and sheep. Now those persons who diversified their business will survive (Firm 5 - Meat Processor).

4.4 Conclusion

The qualitative study presented in this chapter is an exploratory field study of the Australian agri-food industries. The main aim was to address the Research Questions stated in Chapter1 and enhance the conceptual research model by discovering the important factors and variables influencing the performance of the agri-food supply chain. It was intended that the enhanced model would be used for a quantitative survey, the second phase of this research. Compared to the preliminary conceptual model, six new constructs and sub-constructs of *structural issues, transaction climate, power, uncertainty, environmental management* and *competitiveness* have been added to the new model based on the findings of the field study. Justification for the new constructs has been made by revisiting the literature and labeling the factors/variables of the field study with the independent factors/variables of past studies within the framework of TCE, RBT and KBT.

Data in this qualitative study were collected through in-depth interviews with eight agri-food firms representing farmers/producers, processors and retailers from different agri-food business chains in Australia. The initial theoretical model used insights from RBT/KBT and TCE to explore how structural and economic issues of organizing inter-firm relationships, transactional climate and information/knowledge assets influence the supply chain performance and benefit to develop the overall performance and competitiveness of the industry. The study revealed that a low trust buyer-supplier environment, dominance of the spot market and isolation of the growers from rest of the food chain affect the profitability and productivity of the upstream food producers. The growing bargaining power in the retailer sector seems to have been a major influence in setting the product price and distribution of margins within the chain. Evidence indicated a need for more coordination and integration from the downstream industries to include the upstream producers as one of the integral parts of supply chain, not simply as price takers, but for sharing the risk and benefit equally in the chain.

Findings also suggested minimizing the total cost of transactions by engaging all the stakeholders of the supply chain with a symmetric knowledge flow for standardizing the contracting terms, setting joint planning and investment areas, developing trust and directing consistent power. Thus, it is possible to achieve farm-level innovation by creating/utilizing knowledge assets, making equally beneficial contracts, creating long-term relationships and trust with other members and, thereby, building the supply chain as a source of sustained competitive advantage for overall better firm performance.

The next phase of the research was to analyze further the combined model as presented in this chapter, to develop formal hypotheses and conduct a survey to test them. Partial least square based structural equation modeling was used for that purpose.

Chapter 5
Final Research Model and Hypotheses*

5. 1 Overview

The previous chapter on the qualitative field study presented the combined model developed from the literature (conceptual model presented in Chapter 2) and from the field study findings (presented in Chapter 4). Using this combined model, the current chapter concentrates on finalizing the research model focusing on the Australian beef industry to apply the model in a particular context and test the hypotheses. The research model and the hypothesized relationships are illustrated in Figure 5.1. This chapter also provides an explanation of how the reflective and formative measures in a higher order multi-dimensional construct are developed. Following the explanation of the model, details of the hypothesized relationships between each of the independent and dependent constructs is discussed.

5.2 Selection of a Particular Food Industry for the Survey

The findings of the qualitative study helped to delve deeper into the related factors and variables influencing the supply chain performance of the Australian agri-food industry. Based on the theoretical model (discussed in Chapter 2) and the combined

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* Part of this chapter has been presented at the following conferences:

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Knowledge asset and inter-organizational relationship in the performance of Australian beef supply chain, in *Proceedings of the Fourteenth Pacific-Asia Conference on Information Systems (PACIS)*, 9-12 July, 2010, Taipei, Taiwan.

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Impact of inter-organizational relational mechanism on Firm Performance: some exploratory findings in Australian agri-food Industry supply chain, , in *Proceedings of the* Oxford Business and Economics Conference (OBEC), 28-30 June, 2010, St Hugh's College, Oxford University, Oxford.

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Inter-firm relationships and performance factors in the Australian beef supply chain: Implications for the Stakeholders, in *Proceedings of the Australian Agricultural and Resource Economic Society (AARES) National conference,* 10-12 February, 2010, Adelaide.

Uddin, M.N. and Quaddus, M. 2008. A theoretical insight of knowledge asset and transaction climate in the Agri-food Industry Supply Chain: Perspective of Australia, In: *17th Annual IPSERA Conference, 9-12 March 2008, Perth, Australia.*

model drawn from the findings of qualitative study (discussed in Chapter 4), it was decided to finalize the agri-food industry supply chain performance model by revisiting the literature and where possible labeling the constructs and the variables in line with the past literature. The qualitative findings also fulfilled objectives of the study; to explore and characterize the use of current knowledge management, IOS, and transactional relationships in the agri-food industry supply chain. At this stage the researcher found that the contribution of the study can be more practical and beneficial if a particular food industry is chosen to apply the model and test the research hypotheses. The findings of the field study, where two producers and one processor from the beef industry were interviewed, indicated important issues in supply chain relationships, knowledge sharing and electronic system use which are related to the profitability and performance of the industry. After consulting with academic supervisors and experts from the Department of Agriculture and Food (DAFWA), the beef industry was identified as the most preferred sector and finalized for the confirmatory phase of the study to identify the important predictors/factors of supply chain performance. Moreover, because of the relative importance of the beef industry in the Australian economy, DAFWA agreed to sponsor the cost of the survey in two states of Australia.

5.3 Motivation and Expected Outcome

The meat and livestock industry in Australia accounts for more than 45 per cent of Australia's total value of agricultural production, within which beef is the largest industry in value terms (Nossal, Sheng and Zhao 2008). 1n 2007-08, the industry value was around A$ 11.6 billion with export earning of around A$ 5 billion from beef and live cattle export (MLA 2008). But the industry is experiencing a long-term decline in terms of trade, and has lagged behind other industries in rates of productivity improvement (MLA 2008). While high input and production costs are a major concern, an increasing report of low returns to the producer end, less competitive environment, less expansion of global market, pressures of climate change and a degrading resource base are the major impediments of productivity and sustainability in the industry. As it is critical for the economy that the beef industry maintains profitability and sustainability; it is believed that the performance, competitiveness and success of the industry depends on improving cost efficiency and productivity which requires a study of the whole supply chain and relationships among the participants in the industry.

Therefore, this part of the study into the Australian beef industry supply chain is expected to contribute significantly in both theory and application. On the theoretical side the study is developing a comprehensive, reliable and valid model of the Australian beef industry supply chain performance via a combination of qualitative field study and quantitative national survey. The significant factors of supply chain performance will provide new knowledge to the supply chain performance literature.

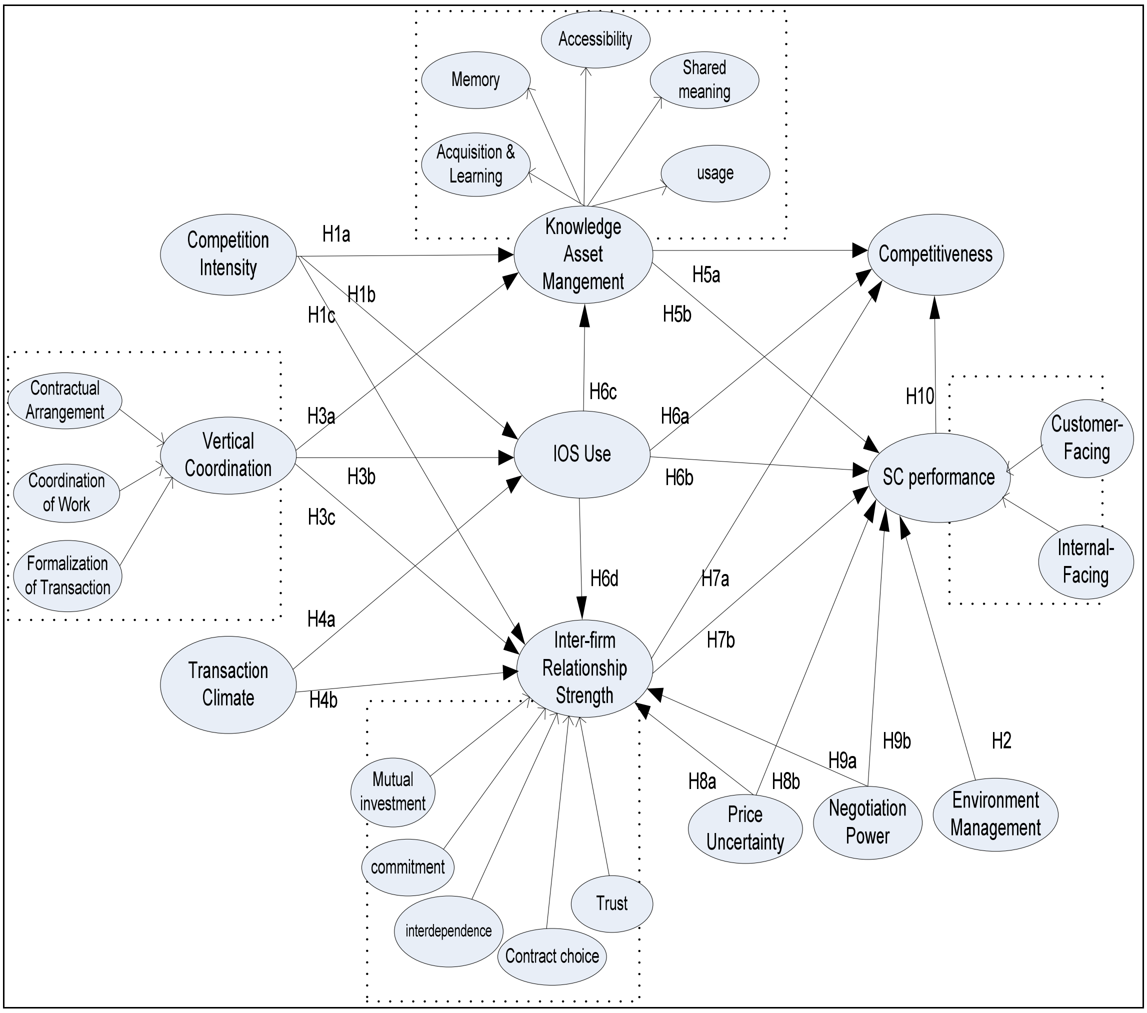
On the applied side the study will make extremely valuable contributions by identifying the significant supply chain performance factors of the Australian beef industry in a systematic way, which will be valuable information for beef producers, processors, retailers, other stakeholders and government departments. This will enable them to undertake appropriate planning and benchmarking to improve the performance of the industry.

5.4 Final Research Model

The final research model, with associated factors, variables and their theoretical relationships, was developed combining the theoretical framework of RBV/KBV/TCE (see Chapter 2 for details) and the model identified in the field study (Chapter 4). The selection of the beef industry necessitated revisiting past studies and redefining some factors and their measurement items as best suited for the meat industry domain in Australia. In addition to the details of the research model, associated constructs and the measurement items, a description of the hypothesized relationships are elaborated in the following sections of this chapter.

The final model as illustrated in Figure 5.1, presents the latent variables and the hypothesized theoretical relationships investigated between the predictor and predicting variables. The factors ‘competition intensity’ and ‘vertical coordination’ are designed as exogenous variables and predictors of ‘knowledge asset management’ and ‘IOS’, and indirectly will influence the ‘SC performance’ and ‘competitiveness’ of the industry, while competition intensity, vertical coordination, transaction climate, IOS, price uncertainty and negotiation power are designed as predictors of 'inter-firm relationship strength'.

Figure 5.1 Finalized Research Model



At the next level, the factors of knowledge asset management, IOS use, inter-firm relationship strength, negotiation power price uncertainty and environmental management practices are modeled to influence the SC Performance, while the paths emanating from knowledge asset management, IOS use, relationship strength and SC performance affect the competitiveness of the industry as a whole.

At the construct level, there are four second-order multidimensional latent constructs; i.e., constructs with more than one dimension named as vertical coordination, knowledge asset management, inter-firm relationship strength and SC performance.

These higher-order constructs are modeled as being caused by first order latent variables or sub-constructs. A second order construct/factor is modeled as being at a higher level of abstraction which, essentially, is created by using all the indicators from first-order factors (Chin 1998a). For example, the construct inter-firm relationship strength in the research model is a second-order formative construct. It is created using linear composites from items used to measure its five sub-constructs/first-orders of mutual investment, interdependence, commitment, trust and contract choice, that are used as formative indicators for the second-order construct. Factor score is used to compute the linear composites of the first-orders (Rai, Patnayakuni and Seth 2006). Similarly, the construct of vertical coordination is created from the linear composites of the items of three sub-constructs. Knowledge asset management and SC performance are also created in the same way as higher-order constructs.

There are three ways to relate the MVs (measurement variables) to their LVs (latent variables); viz., the reflective way, the formative way and the MIMIC (multiple effect indicators for multiple causes) way – a mixture of the reflective and formative indicators (Tenenhaus *et al.* 2005). The model in this study has relied primarily on reflective measures for the first order latent variables whereby the items are caused or driven by the construct and reflect a common theme, while formative measures (the items caused or defined by the construct where the latent variable is generated by its own measurement variables), first introduced by Blalock (1964), are also used for the three second-order constructs of vertical coordination, inter-firm relationship strength, and SC performance as they are composed of indicators with different dimensions. Formative constructs are formed by several indicators representing different independent phenomena (Chin 1998b). The decision to model a construct as formative should be based on four major criteria: i) the indicators are defining characteristics of the construct, not necessarily correlated where the direction of causality is from indicators to construct; ii) indicators need not be interchangeable and dropping an indicator may alter the conceptual domain of the construct; iii) covariation among indicators is not necessary; and, iv) the nomological net of antecedents and consequences of indicators may not be the same (Jarvis, MacKenzie and Podsakoff 2003).

Except the four second-order factors, all first order and other latent variables in the research model have relied on reflective multi-item scales most of which are derived from previous studies. Table 5.1 presents the factors and their definition used in this study

Table 5.1 Definition of the Constructs and Sub-Constructs Used in the Study

<table>
<tr><th>Construct and sub-constructs</th><th>Definition</th></tr>
<tr><td>Competition Intensity</td><td>The presence of industry competitors that influence strategic decision (Bourgeois 1985; Buchko 1994; Porter 1985; Saeed, Malhotra and Grover 2005; Tsay and Agrawal 2000).</td></tr>
<tr><td>Environment Management practices</td><td>Degree to which the positive animal welfare and waste management practices exist in the production and distribution of beef and livestock (Hall 2000; Lamming and Hampson 1996).</td></tr>
<tr><td colspan="2">Vertical Coordination
Organization of a supply chain where each successive stage in the production, processing, and marketing of a product is appropriately managed and interrelated. Based on TCE, and the work of Clare, Shadbolt and Reid (2005); Hobbs and Young (2000), Schulze et al. (2006) and Peterson and Wysocki (1997). This study conceptualize VC using three dimensions as follow:</td></tr>
<tr><td>Coordination of work</td><td>Degree of coordination in terms of asset specificity, sales date and delivery in SC.</td></tr>
<tr><td>Formalization of Transaction</td><td>Degree to which inter-organizational activities are governed by rules, procedures and policies.</td></tr>
<tr><td>Contractual Arrangement</td><td>Degree to which specific and detailed conditions of exchange of a product are specified.</td></tr>
<tr><td colspan="2">Transaction Climate
The sentiments or the behavioral factors that exist in the buyer–supplier relationship. TC is conceptualized in terms of Goal Compatibility, Mutual understanding, Commitment, and Symmetry in inter-firm relationship (Bensaou 1997; Duffy 2008; Duffy and Fearne 2004; Nidumolu 1995; O'Keeffe 1998).</td></tr>
<tr><td colspan="2">KAM
Refers to the dynamic ability of creating and utilizing knowledge assets in supply chain. Based on RBV/KBV, and the work of Hult et al. (2006), Ketchen and Hult (2007), Ackerman (1994), the following five KAM dimensions are used:</td></tr>
<tr><td>Acquisition and Learning</td><td>Ability (e.g., data mining, case based reasoning) to build SC knowledge from experience, expertise and existing data source.</td></tr>
<tr><td>Memory</td><td>Acquired and stored level of knowledge, experience (e.g., repositories, databases, electronic bulletin board) and familiarity with supply chain operations.</td></tr>
<tr><td>Accessibility</td><td>Ease of retrieving, accessing, transferring knowledge asset among SC partners.</td></tr>
<tr><td>Shared meaning</td><td>Distribution and shared understanding of available SC information.</td></tr>
<tr><td>Usage</td><td>Application of knowledge in solving particular problems.</td></tr>
<tr><td colspan="2">IOS Use
The volume, depth (degree of interpenetration) and diversity (number of transactions) of using an electronic system for communicating or exchanging data with partners in the supply chain (Premkumar 2000).</td></tr>
<tr><td colspan="2">Inter-firm Relationship Strength
The economic and behavioral factors that provide strength in alliances or partnerships in SC</td></tr>
</table>

relationships. Based on RVB and the work of Clare, Reid and Shadbolt (2005), Duffy (2008), Duffy and Fearne (2004) and Meloni and Benton (2000); relationship strength is conceptualized using the following five dimensions:	
Mutual investment	The situation when more than one party makes investment in production, marketing or delivery process.
Commitment	"Desire to develop a stable relationship and a willingness to make short term sacrifices to maintain it" *(*Terawatanavong, Whitwell, and Widing 2007, p. 919*)*.
Interdependence	The acknowledgement of a firm's dependence on a partner and their need to maintain a relationship with that partner (Clare Reid and Shadbolt 2005; Mohr and Spekman 1994).
Contract Choice	Degree to which a short-term or long-term contract is preferred for profitability and planning security (Szabo and Bardos 2006; Hobbs 1996; Petersen and Wysocki, 1997).
Trust	The belief that an exchange partner is honest/reliable and will not exploit other parties' vulnerabilities (Mayer, Davis and Schoorman 1995).
SC performance The outcome from a coordinated knowledge and relational mechanism in SC in the form of SC reliability, responsiveness, quality, cost and asset (Supply Chain Council, 2004; Gunasekaran, Patel and McGaughey, 2004). SC Performance is operationalized using following two dimensions:	
Customer-Facing	Degree to which the responsiveness and reliability of a firm to its customers is fulfilled in terms of order deliveries and related queries on time.
Internal-Facing	Degree to which the firm improves its service/product quality, cost structure and return from the assets.
Competitiveness Capabilities that allow an organization to differentiate itself from its competitors such as cost efficiency, productivity, marketing, and innovation (Porter 1985; Han, Omta and Trienekens 2007; Tracey, Vonderembse and Lim 1999).	

5.4.1 Modeling the Higher Order (Multidimensional) Factors and their Measures

As stated earlier, that there are four second-order multidimensional latent constructs in the research model; the procedure of developing a hierarchical construct model is followed on the basis of structural equation modeling, more specifically using PLS path modeling through the repeated use of manifest variables from the first order factors (Henseler and Chin 2010; Lohmoller 1989; Tenenhaus *et al.* 2005; Wetzels *et al.* 2009). A higher-order (multidimensional) construct refers to "several distinct but related dimensions as a single theoretical concept" (Edward 2001, p. 144).

Studies propose different approaches for modeling higher-order (multidimensional) constructs and their dimensions within the framework of structural equation modeling (SEM) (see Chin and Gopal 1995; Edwards 2001; Jarvis, MacKenzie and Podsakoff 2003; Law and Wong 1999; Petter, Straub and Rai 2007; Wetzels *et al.* 2010) which can be divided primarily into two groups on the basis of the directions of relationships between the higher order construct and its dimensions.

i. **Molar model/composite model or formative construct model**: Also called an aggregate construct (Edwards 2001), composite latent variable model (Jarvis, MacKenzie and Podsakoff 2003) and composite latent construct model (MacKenzie *et al*. 2005). In this model, the relationship flows from its first order dimension to the 2nd order construct. The model uses formative indicators (LVj←MVi) as it is hypothesised that changes in the measures cause changes in the underlying construct. Therefore, the measures are referred to as causal or formative indicators and are assigned beta weights in a regression formulation (Jarvis, MacKenzie and Podsakoff 2003). Chin and Gopal (1995) first introduced formative measurement to the IS literature to model a construct using diverse and disparate set of observable phenomena.

ii. **Molecular model/factor model or reflective construct model:** Also called superordinate construct model (Edward 200l), principal factor model (Jarvis, MacKenzie and Podsakoff 2003) and common latent construct (MacKenzie *et al*. 2005). The relationship in this model flows from the construct to its dimension. The model primarily uses reflective measures where the manifest variables are driven by the latent variables (LVj→MVi). Therefore, the covariation among the measures reflects variation in the underlying latent factor.

Also other types of multidimensional constructs exist that can be created by combining the features of reflective and formative construct models. Jarvis, MacKenzie and Podsakoff (2003 p.204) showed that "a first-order construct can have either formative or reflective indicators and those first-order constructs can, themselves, be either formative or reflective indicators of an underlying second-order construct". The author illustrated four possible combination of second-order factor model, such as

i) Reflective first order, reflective second order;
ii) Reflective first order, formative second order;
iii) Formative first order, reflective second order; and
iv) Formative first order, formative second order.

In measuring and analyzing the second-order construct two procedures can be followed: i) repeated use of the first order indicators following Lohmoller's (1989) hierarchical component model that proposed to measure the higher order construct directly using all measurement items of its lower order constructs; and, ii) the second procedure is to model the path from lower to higher order construct to see the relative weight of the lower order latent variables on higher order latent variables. However, it should be mentioned that "the relationship between a multidimensional construct and its dimension are not causal forces linking separate conceptual entities but instead represent association between a general concept and the dimensions that represent or constitute the construct" (Edward 2001 p. 146).

It is also important to note that the choice and utility to model and analyze a construct as a higher order formative or reflective construct depends on the theoretical interest and the underlying construct in the study (Mackenzie *et al.* 2005). A complex construct deserves to be modeled as a multidimensional construct to permit a more thorough measurement and analysis with more theoretical parsimony (Petter, Straub and Rai 2007; Edward 2001), although it is argued that the repeated use of first orders indicators in the higher order constructs may reduce accuracy and validity of the measures as it contains a large amount of specific and group variance (Law *et al.* 1998). But the advocates of the higher order construct have argued that it provides 'holistic representation of a complex phenomenon' with detail on different aspects of the constructs and allows researchers to match broad predictors with broad outcomes (Edward, 2001). Given this trade-off, study argued it as 'theoretical utility' because theory requires a construct consisting of specific dimensions or facets (Edwards 2001; Petter, Straub and Rai 2007). But it is imperative that the second-order factor model should be embedded within a nomological network used as a consequent and/or predictor of other latent variables (Chin 1998).

Finally, it should be mentioned that a higher order multidimensional construct can be estimated using both covariance based SEM (LISREL, EQS, AMOS) and component based SEM (PLS path modeling). Although the covariance based SEM requires various constraints regarding the measurement, identification and factor indeterminacy of a higher order model, these problems can be avoided by using component based SEM, i.e., using the PLS (Chin and Newsted 1999; Wetzels *et al.*

2009). PLS uses an iterative estimation technique consisting of a series of ordinary least squares analysis and provides a general model similar to canonical correlation, redundancy analysis, multiple regression, multivariate analysis of variance and principal components. Therefore, identification is not a problem for the formative and recursive model. PLS estimates the latent variables as an exact linear combination of the observed measures and avoids the factor indeterminacy problem by giving the exact definition of a component score (Chin 1998b)

Based on the aforementioned discussion and related theories, the current study adopted the Molar and Molecular approach (Chin and Gopal 1995; Bagozzi 1988) in modeling the four higher-order constructs in the research model.

5.4.1.1 Molar approach

Similar to the composite model or formative construct model discussed in the preceding sections, the molar approach is a global or macro presentation of individual factors that are conceptually aggregated for 'theoretical utility' into a single summary representation to create a higher-order construct (Chin 1998). By connecting multiple lower-order constructs in a formative direction, this higher order molar construct can capture the entire domain of the construct and can mediate fully the theoretical relationship with other constructs. The approach is used to create three second-order constructs in the research model ('vertical coordination', 'inter-firm relationship strength' and 'SC performance') as illustrated in the Figures 5.2a, 5.2b, and 5.2c based on the following consideration:

1. Prior studies/theories suggest that these first order factors can be represented in a global 2nd order latent variable that provide a holistic presentation of the construct with more explained variance
2. The second-order latent variable is expected to fully mediate the relationship of its first order factors to other theoretical relationships with other constructs in the research model.
3. The second-order constructs are expected to have higher criterion-related validity and expecting to exhibit higher predictive validity than their first-order dimensions (Edward 2001)

4. The relative weightings of the first-order factors can be used to indicate their relative importance in constructing the second-order factor (Chin and Gopal 1995)

Figure 5.2a: Modeling Vertical Coordination (Reflective First-Order, Formative Second-Order)

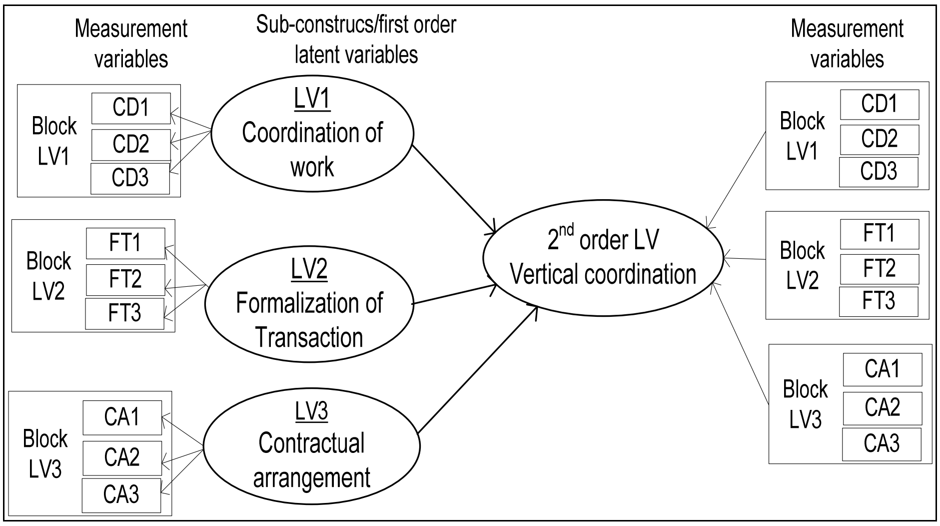


Figure 5.2b: Modeling Inter-Firm Relationship Strength (Reflective First-Order, Formative Second-Order)

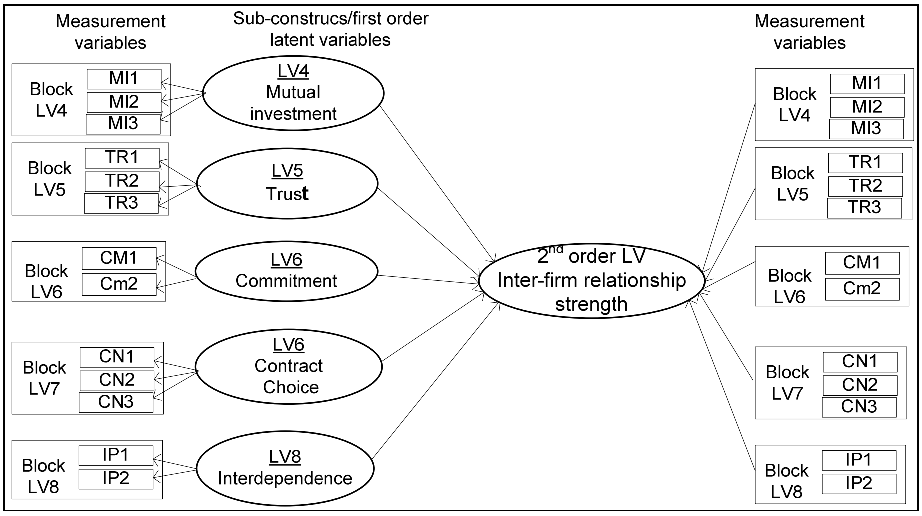
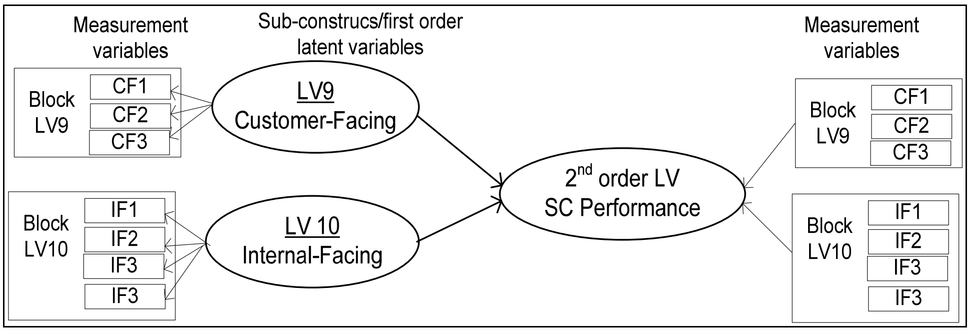


Figure 5.2c: Modeling SC Performance (Reflective First-Order, Formative Second-Order)



In developing the higher-order construct within a Molar approach, the researcher first constructed the first-order latent variables by relating them to their respective manifest variables. Following the guidelines of modeling a latent variable as formative or reflective, as stated before**,** the first-order latent variables were constructed with reflective indicators. Then the second-order latent variable was constructed using the linear composites of the items used to measure each of the first-orders and used them as indicators of the second-order (Rai, Patnayakuni and Seth 2006). But this time the indicators were used as formative measures in the second-order construct following the same guidelines of constructing formative/reflective factor model. The relationship between the first-order and second-order also followed the formative dimension, i.e., from its first order dimensions to the second-order construct. Thus, the molar model is illustrated following the second method of Jarvis (2003), which is the 'reflective first-order, formative second order'.

'Inter-firm relationship strength', as conceptually defined in Table 5.1, was represented in an aggregated single summary construct as the field study (Chapter 5), as well as prior studies, provided empirical evidence that inter-firm relationship strength can be abstracted by several key dimensions such as mutual investment (Williamson1985; Lu, *et al*. 2006; Lambe, *et al.* 2000; Colwell and Vibert 2005' O'Keeffe 1998); trust (Dyer and Chu 2000; Andaleeb 1995; Anderson and Narus 1991; Maloni and Benton 2000; Spekman *et al.* 2000); commitment (Clare *et al.* 2005; Maloni and Benton 2000; Spekman *et al.* 2000), interdependence (Clare *et al*. 2005; Mohr and Spekman 1994); and contractual choice (Szabo and Bardos 2005;

Revell and Liu 2007). The operational definition of these key dimensions was given in Table 5.1.

It has been argued that high quality relationships can be based on willingness to invest and may have greater trust, commitment or interdependence with the notion of continuing it for a longer term for a greater cost saving in SC transactions (Eng and Wong 2006). The theoretical lens from TCE and RBV also provided a strategy framework for developing the supply chain relationship as an intangible asset by examining these key issues of economic exchange in designing and regulating the transactions efficiently. Therefore, although these dimensions of relationships are not necessarily correlated and have been tested independently as separate dimensions or principal factors in different studies, the conceptual appeal and theoretical insight of prior studies suggest that mutual investment, interdependence, commitment, trust and contract choice are associated with the economic and behavioural factors of relationships and provide strength in SC transactions. Thus, they can be represented better in a molar construct, in a global macro level latent factor such as 'relationship strength' (Hausman 2001) for better criterion validity as well as higher predictive validity on supply chain performance and competitiveness. In addition, the modeling of 'relationship strength' as a composite higher order formative construct will help to categorize relationship dimensions in first-order factors and will help to explain the relative weight and association of each of the dimensions on relationship strength and, thus, why some relationships are more effective in achieving SC performance and competitiveness. The path modeling will also explain the first-order factors' contribution to the higher order to mediate and predict other theoretical relationship with other constructs.

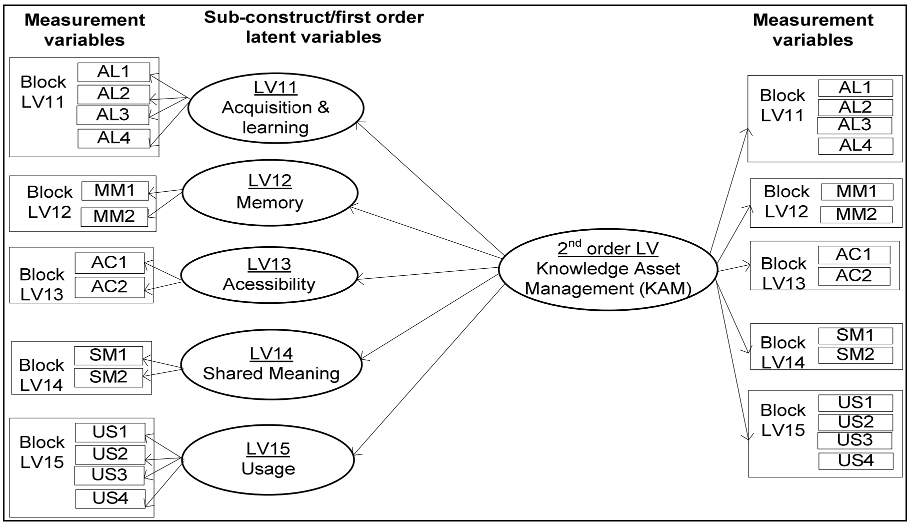
Building on the same ground of TCE, vertical coordination has been conceptualized in a composite molar construct by aggregating three individual characteristics or dimensions of vertical integration; namely, formalization of transactions (Hobbs and Young 2000; Nidumolu 1995), 'contractual arrangement' (Hobbs and young 2000; Mighell and Jones 1963; Peterson and Wysocki 1997; Schulze *et al.* 2006), and coordination of work (Clare, Reid and Shadbolt 2005; Mohr and Spekman 1994). The extant literature review and the findings of the field study helped to aggregate the domain of the construct in a composite summary to define the types of ties conceptualized and to investigate their affect on other constructs as hypothesized. Vertical coordination as defined in Table 5.1 is a higher level of abstraction for the organization of the segments of a production and marketing system in the supply chain. TCE provides useful insight of the development of the concept based on studies which have suggested that vertical coordination can be viewed as a continuum of possibilities and strategies from open or spot market transactions at one extreme, then contract choices, different levels of alliances, and coordination as intermediate forms, and, finally, full vertical integration (Mighell and Jones 1963; Hobbs and young 2000). These strategies are viewed as separate dimensions of vertical coordination and can be aggregated in a formative direction. The reason for the formative direction is that the dimensions are defining characteristics of the construct; they are not necessarily correlated and dropping a dimension may alter the conceptual domain of the construct. As defined in Table 5.1, the dimension 'formalization of transaction' refers to the degree of inter-organizational transaction ranging from a short-term open market transaction to a long-term contract. 'Contractual arrangement' refers to the specific and detailed condition of the buyer seller relationship, while 'coordination of work' refers to the level of vertical interactions on asset investment, production and sales based on which the level of integration can be achieved. Although, there has been considerable research on the individual dimension within the vertical coordination continuum, the concept has never been tested in an aggregated form to investigate its affect on relationship strength and performance in the supply chain. The modeling of this relatively complex concept in a composite higher order molar approach will help to determine the relative weighting and importance of each dimension to the higher order construct, as well as its contribution in predicting the other relationships in the model.

In a similar fashion, SC performance is modeled in a molar approach by aggregating different dimensions to a composite higher order factor. As the performance of the supply chain depends on several independent actors, it is more complicated than measuring the performance of an individual firm (Aramyan *et al.* 2006). Studies have identified different metrics and dimensions of supply chain performance and classified them into strategic, tactical and operational levels of management (Gunasekaran *et al.* 2001, Supply Chain Council, 2004). While literature shows a limited number of properly specified multidimensional constructs (Petter, Straub and Rai 2007), the study of Rai, Patnayakuni and Seth (2006) on PLS path modeling was found to be an example of a properly specified molar model that explored three dimensions of supply chain performance in a higher order model; viz., operational excellence, revenue growth and customer relationships. They were used empirically to test whether or not the aggregated performance of a firm can be influenced by the integration of supply chain processes. Using this example as a valid formative performance model, the current study adopted two dimensions of supply chain performance from the Supply-Chain Operations Reference model 8.0 (SCOR); viz., 'customer-facing' and 'internal-facing' considering the context and domain of the beef supply chain. As defined in Table 5.1, 'customer-facing' refers to the firm responsiveness to its customers in fulfilling the orders, marketing, deliveries, and related queries on time. 'Internal-facing' is defined as the degree to which the firm improve its service/product quality, cost structure and return from assets. The two dimensions are used as first-order latent variables or sub-constructs measured by reflective indicators and then modelled in a formative direction to create the higher-order construct 'SC performance' using all first order indicators. The main purpose of the molar model was to test how the aggregated supply chain performance can influence SC competitiveness in the industry as a whole and, at the same time, which dimensions of performance are more important and effective in predicting competitiveness. The aggregated performance was also tested to determine how it can be influenced by other predictors in the model.

5.4.1.2 Molecular approach

Similar to the factor model or reflective construct model as previously discussed, in the molecular approach it is believed that an overall latent construct exists and can be indicated by the first-order factors (Chin and Gopal 1995); this is the underlying perspective used by covariance based SEM. By connecting multiple sub-constructs or lower-order constructs in a reflective direction, and using composite scores of their measurement items, this higher order molecular approach can be used to define the entire domain of the construct. Then a comparison of the path loading from the second-order construct to each of the first-order constructs can indicate the relative importance of each of the lower-order constructs in reflecting the higher order construct.

Figure 5.3 Modeling Knowledge Asset Management (KAM) (Reflective First-Order, Reflective-Second-Order)



In the current model, the molecular approach is used to construct 'knowledge asset management' as a second-order construct shown in Figure 5.3. Following the guidelines for modeling a latent factor as formative or reflective, the first order latent variables are first constructed with reflective indicators. Then the second-order latent variable is constructed using the linear composites of the items of the first-orders and used them as reflective indicators of the second-order. Thus, the model is created using Jarvis, MacKenzie and Podsakoff (2003) first method: reflective first-order, reflective second-order.

Building on the notion of R-B/K-B theory, 'knowledge asset management' (KAM) in this study refers to the dynamic ability of creating, sharing and utilizing knowledge assets in a supply chain as a source of competitive advantage. The concept is defined by deconstructing the larger concept of 'Knowledge Management' which is a well established field in organizational learning, information processing and strategic decision making. Studies have suggested that sustained firm performance is related to knowledge management capabilities which can be gained by aggregating and developing high impact or incremental new knowledge; distributing and sharing the knowledge between individuals and using the knowledge as an input to build subsequent new knowledge (Bogner and Bansal 2007; Grant 1996; Pitelis 2004). Hult et al. (2006) argued that firm and supply chain outcomes are increasingly intertwined and therefore the supply chain efforts to create and utilize knowledge influence important outcomes.

In another study, Ketchen and Hult (2007) used four first-order indicators – knowledge acquisition, information distribution, shared meaning and achieved memory to create the higher-order construct 'knowledge development' and explore the combined influence on cycle time performance in the supply chain. Thus, the literature provides the basis that the concept 'KAM' in the supply chain can be reflected by combining several dimensions of knowledge management for a better predictive validity on supply chain performance. In the current study five dimensions or first-order indicators were used; i.e., knowledge acquisition and learning, knowledge memory, knowledge accessibility, shared meaning and knowledge utilization. Because the concept 'knowledge asset management' already exists and has independent measures, the perception of the overall 'KAM' in this study can be reflected by combining the dimensions as they share the common theme. But the specific utility of constructing them in a reflective higher order molecular approach was to explain the path loadings of the dimensions for their relative importance of reflecting 'knowledge asset management'

5.5 Hypothesis Development

5.5.1 Hypothesis Related to External Forces

External pressure plays an important role in determining firm policies and performance in a supply chain; for example, the recent rise in environmental issues in food industries has led to major changes in supply and waste management issues of firms (Hall 2000; Green, Morton and New 1998). Researchers have classified the external forces primarily into six groups – competition, customers, technology, regulatory, environment and socio-economic factors for evaluating supply chain uncertainty and firm performance (Claycomb, Droge and Germain 1999; Daft *et al.* 1988; Green, Morton and New 1998; Miles and Snow 1978). In the Australian agri-food context, studies have identified some primary forces of external influence in supply chain, such as: competitors (Claycomb *et al.* 1999; Florida 1996; Islam and Johnson 2003; O'Keeffe 1998; MLA 2008); technological policy (Grover 1993; Gregor, Newman and Larner 1997; Kularatna, Spriggs and Storey 2001; Storer 2007); consumer pressure (Green, Morton and New 1998; Hall, 200; Hobbs 1996; Kularatna, Spriggs and Storey 2001) and environmental issues (Claycomb, Droge and Germain 1999; Hall 2000; Green, Morton and New 1998; MLA 2008). Considering the context of the agri-food industry and the findings of the qualitative study, it was decided to explore the antecedent role of competitors and environmental management practices in the beef industry supply chain performance.

The presence of industry competitors contributes to supply chain innovation (Buchko 1994). Porter (1990) argued that related and supporting industries that are internally competitive are a determinant of competitive advantage. Traditionally, studies support the view that competitors have a significant role in determining strategic goals in manufacturing industries (e.g., Bourgeois 1985; Buchko 1994) and can enhance a firm's ability to differentiate itself by serving as a standard of comparison (Porter 1985). Increased globalization and advancement in technology are enablers of competition, particularly when driven by large multinational food manufacturers and supermarket chains that have the ability to source their input from many different countries and are putting great pressure for change on both Australia's domestic and export oriented food sectors. Evidence from the field study (see the Section 4.3.4.1) showed that in the Australian context, competitors have a great influence that drives the food industry's business strategies and enables them to act in the supply chain by developing a better product, becoming cost efficient and developing better knowledge management and EDI (Electronic Data Interchange) systems. Competitors also have been known to push the industry to improve relationships and co-innovation in a supply chain; e.g., between processors and retailers for competitive strategy and innovation in production and sales. Field study evidence showed that the absence of competition in the Australian beef industry is influencing efficiency and profitability, as well as productivity and performance in the long run. Therefore, the present study hypothesized that a firm facing strong competition is more likely to develop its competitive assets such as developing and utilizing supply chain knowledge and IOS as well as strengthening the inter-firm relationships that ultimately impact on the supply chain performance and competitiveness. Thus, it is hypothesized that:

H1a: Competition intensity in the beef supply chain will positively influence the KAM in the beef industry in the Australian agri-food industry.

H1b: Competition intensity in the beef supply chain will positively influence the IOS use in the beef industry in the Australian agri-food industry.

H1c: Competition intensity in the beef supply chain will positively influence the inter-firm relationship strength in the beef industry in the Australian agri-food industry.

It has been argued that there are parallels between environmental management practices (such as waste management, animal welfare) and supply chain management practices which may lead to overall business efficiency (Lamming and Hampson 1996), as significant environmental burdens are associated with the system of food production, packaging, distribution and marketing (Jones 2002). Therefore, the process through which food is produced, sourced, distributed and marketed increasingly has been a focus of attention for consumers, environmental groups, policy-makers and food producers (Blythman 1998; Jones 2001; Pretty 1998; Hall 2000). For example, positive animal welfare reputation and reduction of the food miles (carbon footprints) increasingly are becoming an important issue for the beef and livestock producers to ensure market access and acceptance. Thus, environmental pressure is relative to other competitive pressures and can influence the production methods and performance in a supply chain (Triebswetter and Hitchens 2004). The current field study also found stakeholders to be concerned about environmental issues such as animal welfare and waste management; because being ‘environment’ concerned is a notion of good corporate citizenship and can help them grow their business. Therefore, the following hypothesis is developed:

H2: Environmental management practices in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry.

5.5.2 Hypotheses Related to Vertical Coordination

Transaction cost economics (TCE) is the most widely used theoretical lens for analyzing the development and impact of relationship structures and their governance in the food supply chain (DenOuden et al. 1996; Hobbs 1996; Schulze *et al.* 2006), even though it was initiated in an economic background. According to TCE, supply chain governance or inter-firm transaction structures are related to the choice of two basic mechanisms - open markets (market forces determine the exchange processes, price and delivery schedule) and vertical integration (hierarchy of coordinating and controlling the successive stages of production and marketing of products under common ownership), which influence the inter-firm transaction process and associated costs (Bijman 2006; Liu *et al*. 2009). Theorists have argued that costs can be grouped into two components – transaction cost and production cost; the first refers to information processing costs to coordinate the work of buying and selling a product, while the second involves producing and distributing a product (Son *et al*. 2005).

TCE asserts that transaction costs are relatively high when a firm outsources materials from the open market; this is due to the cost of searching and selecting reliable suppliers, as well as costs of negotiating, enforcing and monitoring trading partner contracts (Son, Narasimhan and Riggins 2005). On the other hand, production costs can be high when the firm decides to produce the materials in-house through vertical integration rather than purchasing from the open market. Costs also depend on the characteristics of transactions such as asset specificity or relation specific investment (investment that has little or no value outside the specific relationship), opportunism, frequency and uncertainty in the transaction (Grover 2003). For example, a sunk cost rise for a broken contract can be very high if the relation specific investment is high; although the formal contract is a major tool to protect specific investment and safeguard the cost of opportunism. TCE posits that governance structure and relational mechanisms are derived from economic rationality such as when transaction costs of using the open market system rise; it is efficient to carry out transactions by a strategic alliance through contracting or by vertically integrating firms (Hobbs 1996; Williamson 1975).

Based on the work of Williamson (1975, 1985), studies have suggested that the methods of vertical coordination (VC) range from spot market, specification contracts, relation-based alliances and equity-based alliances through to vertical integration, but it is believed that stricter vertical coordination in agri-food chains, specifically in the meat industry, is crucial for better product and information flow, better performance and competitiveness (Duffy and Fearne, 2004; Hobbs and Young, 2000; Schulze *et al*. 2006). It provides a better way of contact, control and contracting cost in the supply chain by addressing the issues of growing quality requirement, food safety and other difficult-to-detect attributes of food products.

The qualitative field study in the Australian agri-food industry has provided evidence (See Section 4.3.4.2**)** of vertical coordination lead by the processing and supermarket chain that has impacted on economic transactions and firm performance. The processing and retailing companies have identified that they have some vertical coordination starting from the spot market through to their contracted producers and suppliers to reduce lead time, increase understanding, develop information flow and ensure required quality and quantity of products. Because of the inherent supply and demand uncertainty, seasonal uncertainty and required freshness of the product, the large retailing companies in Australia have described how that they maintain a grower base supply chain, on top of that the central spot market and brokers on top of that. The qualitative study also provided evidence that meat producers rely on long-term relationships and coordination from the downstream industries to achieve a better margin and profitability. Given the aforesaid discussion and example, it is reasonable to infer that vertical coordination impacts on managing the supply chain knowledge, information flow and the degree of relationship which eventually influences the supply chain performance.

Therefore, it is hypothesized that:

H3a: The level of vertical coordination in the beef supply chain will positively influence the level of KAM in the beef industry in the Australian agri-food industry.

H3b: The level of vertical coordination in the beef supply chain will positively influence the level of IOS use in the beef industry in the Australian agri-food industry.

H3c: The level of vertical coordination in the beef supply chain will positively influence the level of inter-firm relationship strength in the beef industry in the Australian agri-food industry.

The generation of the three hypotheses was induced by the key concept of TCE: bounded rationality (i.e., decision making under partial information or limited capacity to evaluate accurately all possible decision alternatives), information asymmetry (i.e., transactions under incomplete/imperfect information), asset specificity (i.e., transaction specific asset), and opportunism in the relationship. While bounded rationality (Simon, 1961) argues for optimal choices in all decision making situations, a knowledge base can facilitate the decision choices in a supply chain and can provide non-market forms of coordinating economic activities. Hypothesis H3a is proposed based on this foundation. In addition, TCE analyzes information asymmetry and asset specificity as causes of market failure and vertical coordination and provides the basis for Hypothesis H3b and Hypothesis H3C. These hypotheses were designed to explore the impact of vertical coordination on inter-organizational system use and the degree of relationship strength in a supply chain.

In relation to the subject of hypothesis H3a, Ghoshal and Moran (1996) argued that the central advantage of firms is not simply an avoidance of transactions costs in market exchange, but their unique advantages lies in integrating the knowledge of many different individuals in the process of producing goods and services. Similarly, Grant (1996 p.109) provides a knowledge based approach in firms saying that "coordination mechanisms through which firms integrate the specialist knowledge of their members" is the basis of innovation in a firm. His focus is on knowledge creation in contrast to an organization role of focusing on knowledge application only. The approach centres the specific strength of vertical coordination in a supply chain through which organization knowledge that may boost firm performance will be created.

To justify the hypothesis H3b, it is often argued that the time and cost involved in an information search for detecting a suitable buyer/seller, the quality of food and price of the sellable products are reasons for more vertical coordination by circumventing the marketplace (Schulze 2006; Hennessay 1996). Lawrence *et al*. (1997) argued that the quality of a product is one of the major concerns especially in the meat industry and requires the need of an integrated information flow given that open markets are very limited in being able to pass on quality-related information in food chains. In addition, TCE recognizes that imperfect, incomplete or asymmetrical information between the parties making a transaction may increase opportunistic behavior and transaction costs. Therefore, farmers, processors and retailers may save information search and transaction costs through the method of close vertical coordination. Moreover, the field study showed that improved communication and information flow with suppliers is critical for the supermarkets to reduce ordering lead time and save transaction costs. Therefore, it is hypothesized in H3b that vertical coordination may enhance the use of inter-organizational systems among partners in a supply chain.

Finally, as one of the key variables in TCE is the degree of asset specificity, many authors argue that, if the asset specificity or specific investment increases, the spectrum of vertical coordination moves towards a more formal type of relationship such as vertical integration in supply chain (Coase 1937; Hobbs 1996; Mahoney 1992; Roberts 1992; Peterson and Wysocki 1997; Williamson 1975, 1985, 1991). The result may be strategic alliances or a long-term contract or full vertical integration depending on the asset specific investment made by one party, or both, in a mutually agreed case for serving special market segments. The findings from the field study also demonstrated that closer vertical coordination results in specific investment, interdependence and improved trust in the relationship. Therefore, based on the evidence of existing studies and the current field study, it is assumed in H3c that vertical coordination can affect the degree of relationship in a supply chain which eventually affects the firm's performance.

5.5.3 Hypothesis Related to Transaction Climate

On the other hand, Resource Based View (RBV) provides a potential strategy framework to develop the relationship structure as an intangible and non-tradable asset that is difficult to imitate but sustains competitive advantage (Barney 1991; Wernerfelt 1984). It has been argued that sentiments or relational norms, i.e., the transaction climate that exists in buyer–supplier relationships such as the compatibility in goals, commitment and fairness in sharing the risks, benefits and burdens equally reduces opportunistic behavior and increases performance in the supply chain (Clare *et al.* 2005; Duffy and Fearne 2004; Nidumolu 1995; Reve and Stern 1986). The concept 'transaction climate' was introduced originally by Reve and Stern (1976) to describe the sentiments that exist between the parties making a transaction. Duffy and Fearne (2004) found a direct influence of transaction climate on supply chain performance with evidence that the higher the level of co-operative attitude and sentiments, the higher the level of performance, while Bensaou (1997) and Nidumolu (1995) in their studies showed empirical evidence that compatibility in achieving each other's goals and broader perceptions in setting the priorities to achieve common goals have an important influence in supply chain transactions. It has been argued that a partnership should be based on symmetry (Clare *et al.* 2005) where conflict can be productive in the chain when disputes are resolved amicably (Anderson and Narus 1990; Morgan and Hunt 1994; Mohr and Spekman 1994; Duffy and Fearne 2004). Thus a good transaction climate can enable firms to accumulate organizational capital resources such as increased information sharing and reduced opportunistic behavior that may lead to develop rare, valuable, hard to imitate and non-substitutable assets for competitive advantage and sustained firm performance.

The exploratory evidence from the field study also noted (see Section 4.3.4.4**)** that the existence of equality and respect in relationships with commensurate sharing of risks and benefit influenced the degree of inter-firm relationship and on overall performance of the food chain. Findings demonstrated that mutual understanding and common priorities between buying and selling firms have a strong impact on the chain as it can increase the level of confidence among the suppliers; they can drive down unexpected frictions mutually which is important for developing a long-term mutual relationship. While the supplier should know the effect of failure in meeting the required quality of product, the buyer should know the limitations of the seller in delivering the product. Broader perception and understandings of each others work, and its limitation, help both parties work more cohesively and increase performance in the chain. Therefore, the following hypotheses are formulated:

H4a: Transaction climate in the beef supply chain will positively influence the inter-firm relationship strength of the beef industry in the Australian agri-food industry.

H4b: Transaction climate in the beef supply chain will positively influence the IOS use of the beef industry in the Australian agri-food industry.

5.5.4 Hypothesis Related to Knowledge Asset Management

Organizational and economic theories have emerged to explain why some firms are more successful in creating core competencies and capabilities, and in improving their performances and competitiveness (Chandler 1962; Donaldson 1995; Coase 1937; Williamson 1975; Penrose 1959; Wernerfelt 1984; Barney 1991). Literature has shown that knowledge creation, knowledge transfer, firm level learning and other similar approaches are at the heart of gaining sustained competitive advantage (Bogner and Bansal 2007; Grant 1996; Johnston and Paladino 2007; Pitelis 2004). Firms can pursue two aspects of knowledge capital; the resources of knowledge and the processes of knowing, can be well explained by the complementary underpinning of the resource-based view (Barney 1991; Wernerfelt 1984) and knowledge-based view (Grant 1996).

Resource based view (RBV) argues that all resources and capabilities of a firm that are simultaneously unique, rare, imperfectly imitable (costly or impossible to imitate) and non-substitutable (a strategically equivalent substitute is unavailable) lay the foundation for competitive advantage and superior performance (Barney 1991). Resources that have these attributes are strategic assets and mostly intangible such as contracts, employees know how, brand name, product reputation, culture etc. For example, based on the historical experience on inter-firm production management, contracts, investment and associated tools/technologies in a SC, a firm can develop a knowledge base or a knowledge management technique customizing its inter-organizational transaction processes that may help to reduce inventory and procurement costs. Knowledge assets created in this fashion can be a strategic resource that are not readily available to competitors; nor are they quickly imitable and substitutable, and may enhance supply chain efficiencies and outcomes compared to those of other competitors.

Building on the same notion of RBV, knowledge based view (KBV) focuses on the role of knowledge as an asset and capability; it is argued that the unique abilities to learn and exploit knowledge from cooperative efforts enhance organizational innovations and outcomes, thereby sustaining competitive advantage (Hult *et al.* 2006, 2007; Grant 1996). Also, researchers have extended RBV/KBV by highlighting the dynamic capabilities of knowledge creation/application processes in rapidly changing markets such as in a supply chain where building and integrating cutting-edge knowledge is essential for effective strategy and performance (Bueno *et al.* 2008).

In addition to the above argument, the field study showed (see Section 4.3.4.6) that market intelligence and knowledge derived from the sales and inter-firm transactions can be valuable inputs for the processing and retailing firms to create innovation and speed efficiency in supply chain. On the other hand, although producers in the beef industry are detached from the mainstream supply chain, they are utilizing their tacit knowledge of the use of fertilizer, grain and different technologies in the production system. While involved in inter-organizational relationships they are utilizing the feedback of their downstream partners, market transactions and business experiences for innovation and development of the SC capabilities. Thus, based on the evidence both from the literature and field study, the following hypotheses are developed:

H5a: The level of KAM in the beef supply chain will positively influence the competitiveness of the beef industry in the Australian agri-food industry.

H5b: The level of KAM in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry.

5.5.5 Hypothesis Related to IOS Use

The use of inter-organizational systems (IOS) such as electronic data interchange (EDI), web-based procurement systems, electronic trading systems, or supplier relationship management systems can enhance effective flow of information across the supply chain, enhance coordination of supply chain members, knowledge transfer and sharing, and can reduce inter-firm transaction costs of contact, control and monitoring cost (Ali *et al.* 2007; Son *et al.* 2005; Saeed *et al.* 2005). IOS offers greatly improved information flows and improved speediness, responsiveness, performance and competitiveness of a firm (Premkumar 2000; Saeed *et al.* 2005; Evans *et al.* 1993). Transaction cost economics (TCE) has been the dominant theoretical lens in supply chain literature for evaluating the impact of IOS. TCE asserts that information processing to coordinate the work in a supply chain is a main source of transaction cost which, again, depends on information asymmetry (transaction under incomplete/imperfect information) and frequency of transactions between partners (Williamson 1979). Researchers have argued that the use of IOS in a supply chain can play a positive role in reducing information processing and transaction costs (Clemons *et al.* 1993; Premkumar 2000; Malone *et al.* 1987; Son *et al*. 2005), can create competitive advantage and benefits (Porter and Miller 1985; Benjamin *et al.* 1990; Chatfield and Yetton 2000; Subramani 2004) and can influence supply chain performance (Radhakrishnan 2005; Sahin and Robinson 2002; Saeed *et al.* 2005).

Researchers also have used the framework of RBV to assert the contribution of IOS is an infrastructure and strategic resource that can provide greater scope for organizations to exploit their individual capabilities (Borman 2006; Schlueter-Langdon and Shaw 2002) such as knowledge management and inter-firm relationship strength. IOS can influence KAM in that it provides a link among the sources of knowledge to create wider breadth and depth of knowledge flows (Alavi and Leidner 2001). IOS also influences relationship strength because it can be a determinant of the level of trust, commitment and interdependence of supply chain partners (Ali *et al.* 2007; Chatfield and Yetton 2000). Thus, there is always a major push from stakeholders to the companies to use IOS and synchronize their supply chain relationships with an information and knowledge chain for optimizing the demand plan, flow of products and inventory costs in the chain (Proactive Communication 1996). The field study results also revealed that IOS is a competitive tool (see Section 4.3.4.7) by which demand of products can be made visible and feedback can be sent to the upstream industries to align production with desired quality and attributes. Thus, it enhances process efficiency, communication and coordination that results in lowering transaction costs in the supply chain. Based on the above discussion, the following four hypotheses are developed:

H6a: The level of IOS use in the beef supply chain will positively influence the competitiveness of the beef industry in the Australian agri-food industry.

H6b: The level of IOS use in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry.

H6c: The level of IOS use in the beef supply chain will positively influence the level of KAM of the beef industry in the Australian agri-food industry.

H6d: The level of IOS use in the beef supply chain will positively influence the level of inter-firm relationship strength of the beef industry in the Australian agri-food industry.

5.5.6 Hypothesis Related to Inter-Firm Relationship Strength

A large part of SCM literature consists of managing competent inter-firm or inter-organizational relationships such as alliances or partnerships in the supply chain to gain competitive advantage and firm performance. It has been argued that a lack of emphasis on supply chain relations may reduce competitiveness in the marketplace whereas cooperative planning and information sharing in a chain relationship may lead the entire chain to be a source of strategic competitive advantage (Arndt 1979; Dyer and Nobeoka 2000; Kannan and Tan 2003; loader 1997). In an agricultural industry chain, O'Keefe (1998) termed it as 'co-operating to compete', pointing to the shift of competition from firm versus firm to chain versus chain, where firms can run more competitively if they work together in a supply chain in a cooperative environment. Thus, a coordinated supply chain relationship can reduce the risks and uncertainties in transactions and can provide many returns such as lower product and/or service costs, enhanced quality and innovation, and a better firm performance (Carter and Narasimhan 1996; Golicic *et al.* 2003). In a recent study Lee *et al.* (2007) showed that a well-integrated supply chain can be a primary business strategy to improve performance by reducing lead-times and reducing the adverse effects such as bullwhip effects. It has been argued that "long-term relationships lead to reduced political, social or economic risk, reduced transaction costs, and access to economies of scale by by-passing traditional market arrangements" (Loader 1997 p. 24) which, as Arndt (1979) noted, is crucial to compete in the marketplace to achieve greater profit margin and performance. Similarly, some studies have suggested that successful relationships depend on the extent of interdependence between partners (Gattorna and Walters 1996; Mohr and Spekman 1994), while high bilateral dependence positively influences supply chain performance (Anderson and Narus 1991; Duffy and Fearne 2004).

The stream of literature on Agri-food supply chains describes the components of inter-organizational relationships in the political economy framework; they combine efficiency-based and socio-political approaches as complementary to explain the seller-buyer relationships in a social system. Relationships consist of "interacting sets of major economic and socio-political forces which affect collective behaviour and performance" (Benson 1975 cited by Nidumolu 1995 p. 91). Efficiency based approaches have focused on costs and applied theories from microeconomics such as transaction cost theory (Coase 1937; Williamson 1975, 1985) to identify the most efficient structure of transaction in a buyer-seller relationship to emphasize the effects of specific investment and optimization of inter-firm behaviours. Socio-political approaches, such as resource dependence theory (Pfeffer and Salancik 1978) are drawn from organizational and social psychology theories and concerned with trust and power in the marketing channel. The theories suggest that a firm initiates inter-organizational linkages primarily to gain control over a critical resource so as to reduce uncertainty and enhance performance in its transactions, while the approach from an organizational theory such as resource based view (Barney 1991; Wernerfelt 1984) provides a potential strategy framework to develop supply chain relationship as an intangible asset that is difficult to imitate and provides a source of sustained competitive advantage in the chain.

Based on the above discussion, it was hypothesized that a perfect synergy of economic and behavioural factors such as reciprocal investment, interdependence trust and commitment are related to inter-firm relationship strength and will influence the performance of the agri-food industry, specifically in the beef industry and will influence their competitive advantage. Thus, the following hypotheses are made:

H7a: The strength of inter-firm relationships in the beef supply chain will positively influence the competitiveness of the beef industry in the Australian agri-food industry.

H7b: The strength of inter-firm relationships in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry.

5.5.7 Hypothesis Related to Price Uncertainty

In Transaction Cost Economics (TCE), uncertainty is a central theme that affects the size of transaction costs and firm performance (Bijman 2006; Hobbs and Young 2000; Van derVorst and Beulens 2002; Williamson 1985). Many authors believe that standard TCE arguments typically refer to the growing uncertainty in a food chain especially in the meat industry to give reasons for encouraging closer vertical coordination to minimize the uncertainties of inter-firm transactions (Hobbs and Young 2000; Schulze *et al.* 2006; Hobbs *et al.* 2002; Hennessay 1996). The field study found (see Section 4.3.4.8) that lack of vertical coordination and lack of a stable market result in high price volatility in the Australian beef industry, especially for the upstream industries where price uncertainty is a major factor. Hobbs (1997) discussed uncertainty in cattle marketing as a cause of higher transaction costs such as the cost of information search, monitoring and sorting costs by dividing them into two components; viz., price uncertainty which imposes a greater information cost, and grade uncertainty which imposes greater monitoring cost. At the producers' level, price uncertainty may involve the compliance of grading if there is a problem of finding a buyer because it would cause the cattle to lose required grade and weight. Due to the natural variations in quality, seasonal patterns and process yield, uncertainty may proliferate in the beef supply chain through variations in demand and supply and can be worse if there is incomplete or imperfect information between the participants. For example, the brokers/trading agent may thrive their business by concealing accurate information of the market requirements (Lee and Clark 1996). Therefore, researchers have argued that strong relationships with key suppliers and customers may reduce uncertainty and minimize risk in the supply chain (Handfield and Nichols 1999; VanderVorst 2002). Similarly, long-term relationships based on mutual trust and commitment can minimize uncertainty (Cai *et al.* 2006).

Thus, it is believed that price uncertainty has a negative relationship with the strength of inter-firm relationships and firm performance. Consequently, there is a need to move towards a more formalized relationship structure, more inter-organizational interactions for decision information sharing and long-term relationships to minimize the risk (VanderVorst and Beulens 2002). Based on these arguments the following hypotheses are developed:

H8a: Price uncertainty in the beef supply chain will negatively influence the inter-firm relationship strength of the beef industry in the Australian agri-food industry.

H8b: Price uncertainty in the beef supply chain will negatively influence the SC performance of the beef industry in the Australian agri-food industry

5.5.8 Hypothesis Related to Negotiation Power

Power is defined as the ability of one firm to influence the intentions and actions of another firm (Maloni and Benton 2000) while negotiation power is related to the capacity of one party to influence others because of size or status. Researchers have applied different power bases to chain relationships and found direct implications of power circumstances that have a significant affect on inter-firm relationships and, consequently, on chain performance (Cox 1999; Duffy and Fearne 2004; Maloni and Benton 2000). Studies suggest that there are specific supply chain power circumstances based on commitment, dominance and interdependence for which different relationship management approaches emerge (Cox *et al.* 2007), though there are contrasting views of the use of power in a supply chain. Opportunistic perspectives suggest that power increases exploitative tendencies and may encourage a disproportionate sharing of benefits with less powerful partners, and the benevolent perspective suggests that power is associated with functional coordination that comes only through the emergence of a chain driver to increase sales, reduce costs and risk, and increase speed and reliability of the supply chain (Duffy and Fearne 2004; Daviron and Gibbon 2002).

Interviews in the qualitative study of the meat industry provided evidence (see Section 4.3.4.3) that different power circumstances can influence the elements of inter-firm relationships and supply chain performance such as trust, inter-firm contracts, commitment and symmetry of the chain participants. The study found that the producers' share of the market is decreasing because of the growing bargaining and negotiation power used at the wholesaler and retailer levels. The existing imbalance of power enables the Australian fresh food chain to maintain imperfect competitive environments made up of incomplete contracts and a disproportionate share of benefits, i.e., large firms such as processors, wholesalers and retailers are extracting as much value as possible on the basis of their critical assets and control of resources based on the circumstances that give them bargaining or market power**.**

However, the bulk of research on chain relationships suggests that the use of power in a mediated way (coercive, legal) has an inverse affect on relationships and performance. It has been found that coercive or mediated power increases conflict and has a negative affect on commitment and cooperation in inter-firm relationships due to reduced satisfaction, benefits, and resentment of those in subordinate situations. Others have found a positive association between non-mediated power such as expert, referent and legitimate power (Brown *et al.* 1995) and chain cooperation and commitment. The current study assumes that to play a consequential role in the formation and maintenance of supply chain relationships, a firm should have some degree of negotiation power that may come from its cooperative arrangements, a larger market share, and/or brand penetration. A positive, pro-active supply chain is only enforceable or likely to emerge when there is consistently less dominance and more interdependence among the chain participants (Revell and Liu 2007).

Based on the above discussion the following hypotheses are developed in the study:

H9a: Negotiation power in the beef supply chain will positively influence the inter-firm relationship strength of the beef industry in the Australian agri-food industry.

H9b: Negotiation power in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry

5.5.9 Competitiveness through Supply Chain Performance

Competitiveness refers to capabilities that allow an organization to differentiate itself from its competitors and is an outcome of critical management decisions (Jie *et al.* 2007; Tracey *et al.* 1999). Recent studies have noted that firms actually achieve competitive advantage by leveraging the management of their supply chains (Fearne 2008; Ketchen and Hult 2007). The seminal work of Porter (1985) formed the basis for the development of supply chain enablers and their ties to firm performance and competitive advantage. While Porter focused on improving the activities of a value chain, i.e., the value a firm is able to create for buyers that exceeds the firm's cost of creating it, is a source of competitive advantage, other studies (Proactive Communication 1996; Lee 2002; Ketchen and Hult 2007) have argued that performance improvement in a supply chain provides competitiveness of the industry as a whole.

The current field study (see Section 4.3.4.9) revealed that due to the high uncertainty in the agri-food industries to meet the increasing standards of quality, freshness and value for money that consumers spend, agri-food industries are developing their strategies stemmed by the performance of the supply chain to increase competiveness. Studies have revealed that participants from upstream to downstream industries in SC have their own competitive and marketing strategy to keep them viable in the business; such as producers are diversifying their products and developing alternative marketing strategies to increase their competitiveness and profitability in the food chain (Uddin *et al*. 2010). Processors and retailers are improving their cost efficiency by emphasizing rapid delivery of products, reducing distribution steps and lead times, and using highly effective supply chain systems. Capitalizing on these efficiencies in a supply chain, firms are gaining competitiveness in fulfilling customer/consumer demands with the availability of product and the convenient cost and time they want. Based on the above discussion, therefore, it is hypothesized that

H10: SC performance of the Australian beef supply chain will positively influence the competitiveness of the industry.

5.6 Summary

This chapter has provided the finalized research model and 22 hypotheses to be tested based on the survey data. A detailed explanation and justification of the research model, higher order constructs and their measures (both formative and reflective), and the hypothesized relationships are provided; targeting to test them in a specific agri-food industry – primarily the Australian beef industry. The hypotheses are drawn to test performance factors based on the model combined from the literature review and results from the field study about the supply chain performance and competitiveness. The following chapter details the development of a questionnaire and survey instruments and pre-testing of the questionnaire through a pilot survey.

Chapter 6
Questionnaire Development and Survey Pre-testing

6.1 Introduction

The previous chapter provided the final research model and research hypotheses developed combining the findings of a literature review and the results of a field study. This chapter follows on from Chapter 5 to explain the development of the survey instrument; the survey questionnaire and its measures. It also details the pre-testing of the survey – a range of testing techniques and a pilot study prior to the actual survey to minimize the possible occurrence of survey errors and ensure valid, reliable and unbiased results.

6.2 Measurement Instrument Development

The success of a study is dependent on the ability to develop a sound measurement scale, and the ability to accurately and reliably operationalize the constructs for observing true covariances between the variables of interest in the research (Hinkin 1995). Bearing this in mind, the questionnaire and the measurement items for each of the constructs and sub-constructs in this study were developed and adapted based on past studies aligned with the findings of the qualitative field study in this research (discussed in Chapter 4). In particular, the majority of the questions about *competition intensity, vertical coordination, transaction climate, negotiation power* and *price uncertainty* constructs were developed from scratch, based on field study and from the literature related to transaction cost economics, resource based view and knowledge based view in agribusiness. Other major constructs of *knowledge asset management, inter-firm relationship strength, supply chain performance* and *competitiveness* also used measures developed from the combination of previous studies and field study findings.

The study used subjective measures of key respondents, although the results are replicated with important objectives measures of firm performance. Almost all of the questions were based on a seven-point Likert scale; except those that are used for demographic data which are principally descriptive in nature. The 7-point scale ranges from strongly disagree to strongly agree or never to always were used on purpose to overcome limitations of the telephone survey method. It was decided to use a telephone survey using the computerized version of the questionnaire, trained interviewers and the computer assisted telephone interviewing (CATI) system (Zikmund *et al.* 2007; Niemann 2003), because wide geographical distance of the sample states made it difficult to use face-to-face interviews, while a mail survey was also ruled out based on the increased reports of a lower response rate in Australia, especially from respondents in top level management (Jackson, 2008). As respondents cannot see the scale and have limited ability to recall response categories in telephone interviews, it is often recommended to use multiple-category numerical scales that simply ask the respondent to give a number as an answer; for example from between one to five, or zero to ten where the starting and end-points of such scales can be anchored as 'never … always' or 'very poor … very good' among others (Dawes 2001).

The questionnaire (see Appendix 2) was designed targeting a completion time within 20 minutes and having two different computerised versions with slight changes in wordings of some of the questions based on the primary role of a participant as a buyer or seller. As a result, some first order constructs/sub-constructs used only two items to keep the length to a minimum. The questionnaire opened with a brief note introducing the organizations involved in the research, objectives and how the research outcomes will be useful for them, along with the assurance of confidentiality. Then, the sequence of questions was started by recording the categories of participants in the beef industry and, if a primary producer, whether they had a minimum of 100 beef-cattle. The second section of the questionnaire asked about the competition intensity, environmental management practices and the factors related to the structure and strength of the buyer-seller relationships. The third and fourth sections of the questionnaire were related to use of an inter-organizational system and knowledge asset management, while Section 5 focused on performance and competitiveness in the industry. The last section of the questionnaire was about collecting the demographic data of the participating firm.

6.2.1 External Factors in Supply Chain Performance

As mentioned in Chapter 5 (Section 5.5.1), the study uses two external factors competition intensity and environmental management practices to examine their antecedent role in the agri-food industry supply chain. Both the field study and literature provided evidence that two of the external factors can influence the performance of the Australian agri-food industry. As a result, three items for *competition intensity* and two items for the *environmental management practices* were generated from the literature and from the findings of field study as presented in Table 6.1. The items of competition intensity were used to measure their impact directly on knowledge asset management, IOS use, and inter-firm relationship strength, while the items of environmental management practices were used to measure the impact on supply chain performance.

Table 6.1 Survey Items Related to the External Factors of Supply Chain Performance

Construct Name: Competition Intensity			
Item	**Variable**	**Measure**	**Source References**
CP1	Competition intensity	Competition in our industry is intense	Buchko 1994; Porter 1985; Saeed, Malhotra and Grover 2005.
CP2	Market share	We aggressively try to hold on to our share of the market (e.g., by competitive strategies, innovation)	Saeed, Malhotra and Grover 2005.
CP3	Technology policy	We have an aggressive policy of using technology to remain competitive	Adapted from field study.
Construct Name: Environment Management Practices			
EV1	Animal welfare	We have high animal welfare standards in both production and transportation	Adapted from field study.
EV2	Use of energy	We minimize environmental impact by efficient use of resources (Power/water/materials)	Lamming and Hampson, 1996; Hall, 2000.

6.2.2 Vertical Coordination in Supply Chain

Adhering to the key variables of transaction cost economics (TCE) such as asset specificity, information sharing and governance structure of firms, as well as the work of Hobbs (1996), Clare, Shadbolt and Reid (2005) and Schulze, Spiller and Theuvsen (2006) on this theoretical dimension, the construct *vertical coordination* was conceptualized in a formative second-order construct using three individual dimensions or sub-constructs/first-order constructs: *coordination of work, formalization of transaction* and *contractual arrangement.* As discussed in Section 5.4.1.1, the extant literature review and findings of the field study helped to aggregate the domain/subject matter of vertical coordination and to develop items most of which are used for the first time in this study. The literature shows that vertical coordination, which has an important influence in managing knowledge asset, using inter-organizational system and strengthening inter-firm relationship, is a continuum of possibilities where auction/spot market transaction indicate least possible coordination while different levels of contractual relationships and strategic alliances for the integration of production and marketing activities indicate the highest possible coordination. The definitions of the sub-constructs are given in Table 5.1 in Chapter 5.

Table 6.2 presents the items of the three first-order constructs. Coordination of work is measured by three items drawn largely from the literature on TCE to consider the extent of coordination in inter-firm transaction. Formalization of transaction and contractual arrangements also are measured by three items; the first one indicates the level of using auction market and the short- or long-term contracts and the second one indicates the level of contracts in forming strategic relationships. As the study used two different versions of the questionnaire based on the primary role of a company as a buyer or seller (consider the retailer as a buyer in a vertical relationship), the items of contractual arrangement included two statements (one for the buyer and one for the seller) with different wording. In other questions, the term buyer or seller was used interchangeably depending on the version of the questionnaire used for participants during the survey.

Table 6.2 Survey Items Related to the Vertical Coordination

Sub-construct/first-order Construct: Coordination of Work			
Item	**Variable**	**Measure**	**Source Reference**
CD1	Coordination	We have high level of coordination on sales date, delivery times and other transactions with our major buyers/suppliers	Clare, Shadbolt and Reid 2005.
CD2	Asset specificity	We have had investment in our company's asset from our major buyers/suppliers	Szabo and Bardos 2006.
CD3	Information sharing	We often share information that affects our business with our major buyers/suppliers	Clare, Shadbolt and Reid 2005.

Sub-construct/first-order Construct: Formalization of Transaction			
FT1	Transaction structure	Level of using auction/spot Market	Schulze, Spiller and Theuvsen 2006; Hobbs 1996.
FT2	Transaction structure	Level of using short term contract	Schulze, Spiller and Theuvsen 2006; Hobbs 1996.
FT3	Transaction structure	Level of using long term contract	Schulze, Spiller and Theuvsen 2006; Hobbs 1996.
Sub-construct/first-order construct: Contractual arrangement			
CA1	Market specification contract	Our major buyers are obliged to market our production	Hobbs 1996; Szabo and Bardos 2006.
		We are obliged to market our major suppliers' production*	
CA2	Production management contract	Our major buyers specify production practices and quality of our production	Hobbs 1996; Szabo and Bardos 2006
		We specify production practices and quality of our major suppliers' production*	
CA3	Resource providing contract	Our major buyers have full control on our production (e.g., provide key inputs, resources)	Hobbs 1996; Szabo and Bardos 2006.
		We have full control on our major suppliers' production (e.g., we provide key inputs, resources)*	

* The items are used for a separate version of the questionnaire designed for buyer firm

6.2.3 Transaction Climate in Supply Chain Performance

Transaction climate is the construct related to the sentiments and behavioral norms in buyer-seller relationships and was developed from the literature and field study to examine how it influences inter-firm relationship strength and use of an inter-organizational system in the supply chain (discussed in Section 5.5.3). The research of Bensaou (1997), Clare, Shadbolt and Reid (2005) and Duffy and Fearne (2004) underpinned the development of the construct and its measures while field study findings (see Section 4.3.4.4) were used to adapt the measures to be specific to the current research context. Thus, five items were developed to collect data on goal compatibility, mutual understanding and symmetry (existence of equality and respect in a relationship) in the buyer-seller relationship and were used to evaluate the impact of transaction climate. As presented in Table 6.3, two repetitive measures on goal compatibility and symmetry were used to cross check the climate aspect of a firm having both the buyer and supplier role in the supply chain.

Table 6.3 Survey Items Related to the Transaction Climate

Construct Name: Transaction Climate			
Item	**Variable**	**Measure**	**Source Reference**
TC1	Goal compatibility	Our goals are well aligned and compatible with our major buyers	Bensaou 1997; Clare Shadbolt and Reid 2005; Duffy and Fearne 2004; O'Keeffe 1998.
TC1a	Goal compatibility	Our goals are well aligned and compatible with our major suppliers	Bensaou 1997; Clare, Shadbolt and Reid 2005; Duffy and Fearne 2004; O'Keeffe 1998.
TC2	Mutual understanding	We have a very good understanding of each others business (e.g., needs, limitations, expectations)	Adapted from field study.
TC3	Symmetry	We share business risks, burden, and benefits of transaction with our buyers	Bensaou 1997; Clare Shadbolt and Reid 2005.
TC3a	Symmetry	We share business risks, burdens, and benefits of transaction with our suppliers	Bensaou 1997; Clare Shadbolt and Reid 2005.

6.2.4 Knowledge Asset Management (KAM) in Supply Chain Performance

Referring to the dynamic ability of creating, sharing and utilizing knowledge assets in the supply chain, the concept knowledge asset management (KAM) was an important inclusion in the supply chain performance model and was operationalised as a second-order reflective construct using five first-order constructs: *acquisition and learning, knowledge memory, accessibility, shared meaning* and *knowledge usage*. The literature provided the basis that KAM can be reflected by combining the five dimensions as explained in detail in the previous chapters (Section 2.5.2 and Section 5.4.1.2). The importance of the dimensions in the agri-food industry supply chain was also emphasised by the participants of the field study (Section 4.3.4.6). Thus, based on the knowledge of field study and the work of Hult et al. (2006), Ketchen and Hult (2007), and Ackerman (1994), a total of 14 items were adapted to measure the five sub-constructs presented in Table 6.4. Linear composites of the items of these five sub-constructs were used, then, for measuring the higher-order concept 'knowledge asset management' and its influence in achieving competitiveness and performance in the supply chain.

Table 6.4 Survey Items Related to the Knowledge Asset Management

Construct Name: Knowledge Asset Management			
Item	**Variable**	**Measure**	**Source Reference**
AL1	Acquisition and learning	We collect data on our customers, product prices, and distribution channels	Adapted from field study.
AL2	Acquisition and learning	We do a lot of in-house research on products we may produce or sell	Hult, Ketchen, and Arrfelt 2007; Hult *et al*. 2006; Kohli, Jaworski and Kumar 1993.
AL3	Acquisition and learning	We regularly meet to find what products and or partners we may need in future	Hult, Ketchen, and Arrfelt 2007; Hult *et al*. 2006; Kohli, Jaworski and Kumar 1993.
AL4	Acquisition and learning	We spend a great deal of time and resources learning about our supply chain	Hult, Ketchen, and Arrfelt 2007; Hult *et al*. 2006.
AC1	Accessibility	Supply chain knowledge that we have is easily accessible when needed	Hult *et al*. 2006; O'Reilly 1982.
AC2	Accessibility	It is easy to obtain supply chain related knowledge from key people in our organizations	Hult *et al*. 2006; O'Reilly 1982.
SM1	Shared meaning	We share supply management information effectively with our buyers	Hult, Ketchen, and Arrfelt 2007; Hult, Ketchen and Slater 2004.
SM2	Shared meaning	We frequently have meetings (within firm or inter-firm) to discuss current trends and future need on supply management	Hult, Ketchen, and Arrfelt 2007; Hult, Ketchen and Slater 2004; Kohli, Jaworski and Kumar 1993.
US1	Usage	We use supply chain knowledge to improve our sales	Adapted from field study.
US2	Usage	We use our supply chain knowledge to improve our products	Adapted from field study.
US3	Usage	Our existing supply chain knowledge reduced the uncertainty of our business	Hult *et al*. 2006; Deshpande and Zaltman 1982.
US4	Usage	We use our Supply chain knowledge to improve the relationship with our customers	Adapted from field study.
MM1	Memory	We have good systems to store and use our knowledge on supply chain	Adapted from field study.
MM2	Memory	We have a great deal of knowledge to deal with our buyers/suppliers	Hult *et al*. 2006; Moorman and Miner 1997; Hult *et al.* 2006.

Note: The word buyer or seller was used interchangeably depending on the version of the questionnaire in the survey.

6.2.5 Inter-Organizational System Use in Supply Chain Performance

Previous studies have investigated the measure of IOS use as the frequency/volume of use, formality of communication and depth, breadth and diversity of IOS (Angles and Nath 2000; Chatfield and Yetton 2000; Hart and Saunders 1998). But most studies have concentrated on the EDI use and explored the variables to evaluate transaction outcomes in a buyer-seller relation or their effect on the electronic market place. This study adapted five measures of IOS use (as shown in Table 6.5) from the work of Massetti and Zmud (1996), Shi (2001) and Saeed, Malhotra and Grover 2005 and from the finding of the field study to examine how firms have initiated current technologies of IOS in the supply chain and how their use impacts on supply chain performance. The items are *volume* (the number of documents and transactions completed through IOS), *depth* (the degree of interpenetration of partners' business processes through IOS), *diversity* (the extent to which different types documents and transactions are handled through IOS) and *compatibility* with buyer or supplier systems.

Table 6.5 Survey Items Related to the Inter-Organizational System Use

Construct Name: Inter-Organizational System use			
Item	**Variable**	**Measure**	**Source References**
IS1	Volume	A high percentage of our total transactions with buyers/suppliers are conducted through electronic system	Massetti and Zmud 1996; Shi 2007.
IS2	Depth	We can transfer files electronically to our buyers'/suppliers' systems	Massetti and Zmud 1996; Shi 2007.
IS3	Depth	Our system can access our buyers'/suppliers' database	Massetti and Zmud 1996; Shi 2007.
IS4	Compatibility	In most transactions, our system and buyers/suppliers system are compatible to communicate with each other	Adapted from field study.
IS5	Diversity	In the following functions we exchange electronic data with our buyers/suppliers: Purchasing/Ordering Quality Control Production Control Transportation Payment	Massetti and Zmud 1996; Saeed, Malhotra and Grover 2005; Shi 2007.

Note: The word buyer or seller was used interchangeably depending on the version of the questionnaire in the survey.

6.2.6 Inter-firm Relationship Strength in Supply Chain Performance

Like vertical coordination, the literature and the field study suggested that inter-firm relationship strength can be abstracted in a second-order formative construct using five dimensions or first-order constructs: *mutual investment, interdependence, contract choice, trust* and *commitment.* The operational definition of these first-order constructs and the theoretical reasons for aggregating them in a higher order construct is given in Section 5.4.1.1 in Chapter 5. Aspects of inter-firm relationships are also explained in Chapter 2 in Section 2.5.1. A total of 16 items was used to measure the higher order construct most of which are drawn from the study of Clare, Shadbolt and Reid (2005), Duffy (2008) and Premkumar, Ramamurthy and Saunders (2005) and adapted to be specific to the context of the current research using the knowledge gained from the field study (Section 4.3.4.5). As shown in Table 6.6, there were some repetitive measures used for the interdependence and trust constructs as this study found it would be useful to cross check this relationship aspect of a firm having both buyer and supplier roles in the supply chain. In other questions, the term buyer or seller was used interchangeably depending on the version of the questionnaire in the survey.

Table 6.6 Survey Items Related to the Inter-Firm Relationship Strength

Sub-construct/first-order Construct: Mutual Investment			
Item	**Variable**	**Measure**	**Source Reference**
MI1	Mutual investment	We have made a major investment in people and time (e.g., expertise to develop product/service) to develop business practices to meet our buyer/supplier need.	Duffy 2008; Premkumar Ramamurthy and Saunders 2005; O'Keeffe 1998.
MI2	Mutual investment	We have made a major investment in capital to develop business practices to meet our buyer/supplier need.	Duffy 2008; Premkumar, Ramamurthy and Saunders 2005; O'Keeffe 1998.
MI3	Mutual investment	We have made a major investment in processes, infrastructure, and facilities or technologies to develop business practices to meet our buyer/supplier need.	Duffy 2008; Premkumar, Ramamurthy and Saunders 2005; O'Keeffe 1998.
Sub-construct/first-order Construct: Interdependence			
Item	**Variable**	**Measure**	**Source Reference**
IP1	Switch	If I wanted to, I could switch to another buyer easily.	Clare, Shadbolt and Reid 2005; Duffy 2008.
IP1a	Switch	If I wanted to, I could switch to another supplier easily.	Clare, Shadbolt and Reid 2005; Duffy 2008.
IP2	Business disruption	Our buyer would face severe business disruption if we ended our relationship.	Clare, Shadbolt and Reid 2005; Duffy 2008.
IP2a	Business disruption	Our supplier would face severe business disruption if we ended our relationship	Clare, Shadbolt and Reid 2005; Duffy 2008.
Sub-construct/first-order construct: Contract choice			
Item	**Variable**	**Measure**	**Source Reference**
CN1	Contract profitability	We prefer contracts for profitability and planning security	Schulze, Spiller and Theuvsen 2006.
CN2	Contract length	We prefer long-term to short-term contracts	Adapted from field study.
CN3	Contract price	Selling price is always specified in our contracts	Szabo and Bardos 2006.

Sub-construct/first-order construct: Trust			
Item	**Variable**	**Measure**	**Source Reference**
TR1	Trust	Our buyer honors all agreements with us	Premkumar, Ramamurthy and Saunders 2005.
TR1a	Trust	Our supplier honors all agreements with us	Premkumar Ramamurthy and Saunders 2005.
TR2	Trust	We believe our buyers would not deliberately take a course of action that affect us negatively	Duffy 2008; Maloni and Benton 2000
TR2a	Trust	We believe our suppliers would not deliberately take a course of action that affect us negatively	Duffy 2008; Maloni and Benton 2000
Sub-construct/first-order construct: Commitment			
Item	**Variable**	**Measure**	**Source Reference**
CM1	Commitment	We have a high level of business commitment to our buyers.	Clare, Shadbolt and Reid 2005; Duffy 2008, Maloni and Benton 2000.
CM2	Commitment	We have a high level of business commitment to our suppliers	Clare, Shadbolt and Reid 2005; Duffy 2008; Maloni and Benton 2000.

6.2.7 Price Uncertainty in Supply Chain

Six items were developed to measure the construct price uncertainty and assess its impact on inter-firm relationship strength and supply chain performance. The key work of Hobbs (1997) and Premkumar, Ramamurthy and Saunders (2005) provided information that price uncertainty is related to the compliance of the grading/carcass specification system of meat, and that the uncertainty may propagate through variations in the demand and supply of meat. The measures, then, were drawn largely from the findings of the field study (Section 4.3.4.8) and were adapted for the assessment of their impact on beef industry. Table 6.7 presents the measures.

Table 6.7 Survey Items Related to Price Uncertainty

Construct Name: Price Uncertainty			
Item	**Variable**	**Measure**	**Source Reference**
PU1	Supply uncertainty	Over time and season, the supply of beef-cattle or meat fluctuates widely	Adapted from field study.
PU2	Grade uncertainty	We feel that Carcass specification system (weight, fat, conformation) strongly influences our product price.	Hobbs 1997.
PU3	Grade uncertainty	We need to inspect beef-cattle or meat closely to ensure quality and grade	Adapted from field study.
PU4	Price uncertainty	We believe that we are not getting enough margin from our sales	Adapted from field study.

PU5	Price uncertainty	Price fluctuation for our products is a real management problem	Premkumar, Ramamurthy and Saunders 2005.
PU6	Demand uncertainty	There is significant uncertainty in the demand for beef-cattle/meat products	Premkumar, Ramamurthy and Saunders 2005.

6.2.8 Negotiation Power in Supply Chain

In previous chapters (Section 2.5.1.2, Section 4.3.4.3 and Section 5.5.8), and especially in the findings of field study (Section 4.3.4.3), negotiation power has been demonstrated as one of the important influencing factors in inter-firm relationships and supply chain performance. Based on the experience of the field study and the research of Maloni and Benton (2000) and Szabo and Bardos (2006), three items were finally developed and adapted for this study (as presented in Table 6.8) to measure the negotiation capacity and its influence on the beef supply chain. It should be mentioned that NP2 was generated for two separate versions of the questionnaire depending on the firm's primary role as a buyer or seller.

Table 6.8 Survey Items Related to Negotiation Power.

Construct Name: Negotiation Power			
Item	**Variable**	**Measure**	**Source Reference**
NP1	Price negotiation	We have enough influence on the supply chain to negotiate price	Maloni and Benton 2000; Szabo and Bardos 2006.
NP2	Price negotiation	Having to take whatever price offered by the buyers is a great problem	Adapted from field study.
		Determining price with our suppliers is not a great problem*	
NP3	Benefit	We enjoy other economic benefits, in addition to price, from our relationship with our buyers (e.g. determining place and time of delivery)	Maloni and Benton 2000; Szabo and Bardos 2006.

* The item is used for the retailer in a separate version of the questionnaire

6.2.9 Supply Chain Performance

Traditionally, supply chain performance has focused on operational logistics activities, while recent efforts have emphasised reducing of response time and improving quality to satisfy customer expectations. Mainly, prior studies have focused on non-financial factors such as delivery time, cost, quality and customer satisfaction (e.g., Closs *et al*. 2003; Vickery *et al.* 1999), while some also used financial analysis such as Return on Investment (ROI) or Return on Assets (ROA) to determine the chain's performance (Tan *et al.* 1999). But financial performance measure is more difficult to utilize because financial data may not adequately indicate the performance of the system (Beamon 1999) and may ignore opportunity cost and the time value of money (Chen *et al.* 1995; Tan 2002). Strader *et al.* (1999) considered order fulfilment cycle time, inventory level and cost are the best variables to measure the overall supply chain performance, while Vickery et al., (1999) considered flexibility as a key dimension in the chain's performance.

However, as discussed in Chapter 5, Section 5.4.1.1, this study has adopted two dimensions of supply chain performance from SCOR (Supply-Chain Operations Reference) model 8.0 (Supply Chain Council 2004); viz., customer-facing and internal-facing considering the context of agri-food supply chain. SCOR performance measurement variables were designed specially by the Supply-Chain Council[3]; both the financial and nonfinancial variables were included to measure the perception of performance on overall supply chain processes. The variables are reliability, responsiveness, flexibility, cost and asset (Supply Chain Council 2004). Along with the SCOR variables, this study also used the work of Gunasekaran, Patel and Tirtiroglu (2001), and Rai, Patnayakuni and Seth (2006) to develop and adapt measures of customer-face performance (firm's responsiveness and reliability to customers) and measures of internal-face performance (improve service/product quality, cost structure and return from the firm's assets). Thus, using the linear composites of the items of these two dimensions of performance, supply chain performance in the beef industry was measured in an aggregated formative construct (like the vertical coordination and inter-firm relationship strength construct). As presented in Table 6.9, the items were generated to rate how the firm had performed over the last 3 years. For example, 'reliability' was used to measure the quality of the order fulfilment process; 'responsiveness' was used as 'response time' to measure order fulfilment cycle time, customer responses, and speediness of the overall supply chain processes; and finally quality, cost and assets were used to measure the

[3] The Supply Chain Operations Reference-model (SCOR®) has been developed and endorsed by the Supply-Chain Council (SCC), an independent not-for-profit corporation, as the cross-industry standard for supply-chain management. The SCC was organized in 1996 by Pittiglio Rabin Todd and McGrath (PRTM) and AMR Research, and initially included 69 voluntary member companies. Council membership is now open to all companies and organizations interested in applying and advancing state-of-the-art supply-chain management systems and practices (Supply-Chain Council, 2004)

improvement of the internal business performance based on the improvement of product/service quality, supply chain cost and return from assets.

Table 6.9 Survey Items Related to the Supply Chain Performance

Sub-construct/first-order Construct: Customer-Facing			
Item	**Variable**	**Measure**	**Source Reference**
CF1	Reliability	The ability to fulfil order in specified quality and quantity of items	Gunasekaran, Patel and Tirtiroglu 2001; Hult *et al.* 2006; Supply-Chain Council 2004.
CF2	Responsiveness	Ability to fulfil order delivery on time (from the receipt of order to delivery)	Gunasekaran , Patel and Tirtiroglu 2001; Rai, Patnayakuni, and Seth 2006; Supply-Chain Council 2004.
CF3	Responsiveness	Ability to respond to customers queries	Gunasekaran , Patel and Tirtiroglu 2001; Hult *et al.* 2006; Rai, Patnayakuni, and Seth 2006.
Sub-construct/first-order Construct: Internal-facing			
IF1	Quality	Improvement of product/service quality	Gunasekaran , Patel and Tirtiroglu 2001; Rai, Patnayakuni, and Seth 2006.
IF2	Cost	Production, transportation and marketing cost of your business	Gunasekaran , Patel and Tirtiroglu 2001; Hult *et al.* 2006; Supply-Chain Council 2004.
IF3	Asset	Your access to working capital	Supply-Chain Council 2004.
IF4	Asset	Your return from the fixed asset	Supply-Chain Council 2004

6.2.10 Competitiveness from Supply Chain Performance

Although the literature indicated a link of supply chain to generate competitiveness (Porter 1985; Fearne 2008; Ketchen and Hult 2007), the field study provided practical evidence (Section 4.3.4.9) that performance improvement in a supply chain can offer competitiveness for the industry. As a result, the four items of 'cost efficiency', 'productivity', 'market share' and 'innovation' were drawn largely from the findings of the field study and from the research of Han, Omta and Trienekens (2007) to measure how the agri-food industry, more specifically the beef industry, increased competitiveness by streamlining the performance of their supply chain. The items are presented in Table 6.10. Approximately based on the last three years of performance, firms were asked to rate their level of achieving competitiveness on these items.

Table 6.10 Survey Items Related to the Competitiveness in the Industry

Construct Name: Competitiveness			
Item	**Variable**	**Measure**	**Source Reference**
CMP1	Cost efficiency	Our cost efficiency has improved more than that of our main competitors	Adapted from field study.
CMP2	Productivity	We achieved better productivity than that of our main competitors	Adapted from field study.
CMP3	Market Share	Our market share has increased faster than that of our main competitors	Han, Omta and Trienekens 2007.
CMP4	Innovation	We achieved better product differentiation and innovation than our most important competitors	Adapted from field study.

6.3 Pre-testing Survey Instruments

The term ‘pre-testing survey’ refers to a range of testing techniques used prior to the actual survey with the aim of identifying and minimizing the possible occurrence of survey errors to achieve valid, reliable and unbiased results. Traditionally, errors have been classified into two broad categories: i) those connected with survey questions that are misunderstood and cannot be answered by respondents, and ii) those connected with survey interviewers such as not reading the questions as worded or the recording of answers inaccurately (Collins 2003).

In this study, the design and delivery of the telephone survey by using computer assisted telephone interviewing (CATI) caused a major concern regarding the survey layout and design, logical structure and the overall cognitive process of interpreting the questions and answering the questions during the data collection. The complexity arose because “computerized questionnaires require interviewers to manage two interactions, one with the computer and another with the respondent, and the goal of good design must therefore be to help interviewers manage both interactions to optimize data quality” (Presser *et al.* 2004, p. 121). Once the goal of good design, layout and structure of questions is achieved, the major advantage of the telephone survey is greater control on data quality by using existing CATI software and monitoring of the interviewing staff (DeLeeuw and VanderZouwen 1998, p.283).
Traditionally, the commonly used methods of pretesting such as expert reviews, focus group discussions and cognitive interviews have been used in the front-end for identifying problems with the questionnaire at the early stage of development (Hughes 2004) whereas behavior coding, observational interviews and a pilot study can be used as a final stage of evaluating the survey instruments. Studies have

applied a combination of these different methods with some studies preferring a four-stage process for survey pre-testing; viz., i) expert review, ii) cognitive interviews, iii) pilot study, and finally iv) checking the survey by people unrelated to the research project (Dillman 2000; Jackson 2007). However, based on the work of Hughes (2004), ABS (2001) Presser *et al.* (2004) and Jackson (2007) on telephone surveys, the current study applied the following methods for pre-testing the survey instruments:

6.3.1 Expert Review

The first method used was reviewing the newly developed questionnaire, its measurement scales and the logic of the questions against each of the constructs by three professional experts having long experience with working and researching in the agricultural industry value chain. They applied their theoretical understanding, subject expertise and extensive experience to critique questionnaires for potential errors in terms of comprehension, logical structure, redundancy and relevancy of the questions. The suggestions of the experts were extremely helpful in determining the best wording in questions and redesigning the survey layout for gaining accurate and relevant information. At this stage, another major recommendation implemented was the application of different versions of the questionnaire suitable for respondents with the role of buyer or supplier in the supply chain.

6.3.2 Cognitive Interviews

Researchers have argued that verbal reports on survey instruments are a direct representation of specific cognitive processes (ABS 2001; Ericsson and Simon 1993); therefore, cognitive interviews are useful to establish that respondents have understood concepts behind the questions in a consistent way. Consequently, after completing the review by experts, a total of ten cognitive interviews were conducted on respective producers, processors and retailers in the beef industry. The interviews were conducted to develop an understanding of the internal cognitive processes of the respondent when answering a question, the range of likely answers to a question and the level of knowledge needed for an accurate answer. These interviews lasted longer than the actual survey as the respondents were asked to describe aloud their thoughts about a specific question, wording and terms. The checklist, as shown in Table 6.11, was used while conducting the interviews.

Table 6.11 Checklist for the Interviews

No.	Problems
1	Does the respondent have any difficulty understanding the meaning of the question or the meaning of particular words or concepts?
2	Does the respondent have different understandings as to what the question refers?
3	Does the respondent have any difficulty recalling, formulating or reporting an answer?

Source: Adapted from Presser and Blair (1994) and Hughes (2004).

The important outcomes of this method were to change a few of the 'academic' terms to more commonly used words, to reorder the structure and scale of the questionnaire and to include the option of 'no opinion' for respondents not interested in commenting about an item. As reported in Chapter 4, the field study and experts' opinions were useful in determining practical concepts for the survey; concepts were within the cognitive boundary of people working in the industry and limited the need to make changes during the interview process.

6.3.3 Pilot Study

As a third and final step of pretesting, a mini-version of the full-scale telephone survey was conducted by contracting a professional survey research centre from the faculty of computing Health and Science at Edith Cowan University (ECU-SRC). The centre was contracted also to conduct the full survey after the pilot study. As it is an expensive practice to use a professional survey centre for telephone interviewing, the study was able to get a grant from the Department of Agriculture and Food (DAFWA) to cover the costs of the survey.

The experience and expertise of the survey centre in conducting telephone surveys was used to review the survey instrument; once again, for proper wording and logistic clarity in designing and scaling of question items. A total of 68 telephone interviews were conducted to trial the survey within a time line of two weeks that included programming the different versions of questionnaire in CATI, sample management and interviewer briefing and training. The respondents were from the West Australian and Queensland beef industry supply chains and included firms of input suppliers, producers, processors, exporters and retailers. Table 6.12 represents the demographic data of the respondents.

Table 6.12 Demographic Data of the Respondents in Pilot Study

Respondent's Category	Percent
Beef Cattle Producer / Farmer	50.7
Beef meat Processor / Abattoir	19.4
Beef Retailer / Exporter	26.9
Beef Wholesaler	.5
Input Supplier; e.g., feed, livestock, transport	1.5
Average Annual Revenue	
Up to 5 million	83.6
6-10 million	1.5
11-20 million	4.5
Greater than 20 million	9.0
Growth Status	
Established and trying to get bigger	34.3
Mature	11.9
Growing	17.9
Shrinking	6.0
Just surviving	19.4
Winding up/selling/going broke	10.4
Respondent's Role	
Owner	80.6
Supply Chain Manager	9.0
Executive/Officer	9.0
Other – specify	1.5

Responses showed that the majority (51 percent) of the firms were producers, followed by beef retailers (26.9%) and processors (19.4%). The firms were characterized as SMEs; 83.6% of them have up to A$ 5 million of yearly average revenue whereas only 9% had more than A$ 20 million. In terms of growth, 34.3 % said they were established and trying to get bigger, while 19.4% said they were just surviving in the business. However, the trial covered the following two processes to look systematically for any potential problems.

6.3.3.1 Observation and behaviour coding

A close observation of the interviewing process was performed by the survey centre to examine the length, flow, response and acceptability of the interview. Motivational and behavioral aspects, as well as the sensitivity of the rating scales to the respondents, was observed and coded. Finally, the recorded features of interactions between the interviewer and the respondent, specifically the verbalization between the two, were used to identify problematic questions and terminology. Data also were examined to identify any potential inconsistencies, obvious errors and so forth. Thus, revisions were made to some questions; for example, Question 8, asking about the use of IOS (Inter-organizational System) was found to be redundant as Questions 9 and 10 were capturing the same data. It was found also that one interviewer was not able to interpret the relationship between Questions 2.a and 2.b and, consequently, coded data wrongly. This necessitated re-training the interviewer and re-calling the respondents for missed information.

Other revisions resulted in the inclusion of a rating scale as 'refused' for those who declined to answer a specific question, although it was decided not to read out the scale of 'no opinion' or 'refused' to the respondent and it was used only to allow for the further advancement of the interview with respondents who became stuck on a particular answer. The questionnaire was designed to complete the interview within 20-25 minutes to avoid negative reactions to a long survey. The trial revealed that it was possible to complete the interview within 20 minutes by making a minor change in the design; the change contributed to greater participation and a significant reduction in cost.

6.3.3.2 Reliability test

The reliability of a scale or measure refers to the extent to which it is consistent in what it is intended to measure (Hair *et al*. 1998). Since it is argued that questionnaire design and statistical modeling should work in tandem for the survey research to progress (Presser *et al.* 2004), an attempt was made to check the homogeneity and consistency of items in respective constructs in the survey. Coefficient alpha (Cronbach 1951) is the most common and recommended measure of the internal consistency of a set of items and should be the first measure to assess the quality of the survey instruments (Churchill 1979; Nidumolu 1995). It shows how the instrument items are homogenous and reflect the same underlying construct by calculating the estimated correlations of the set of items with errorless true scores (Zikmund 2003). Thus, a low alpha may indicate a poor performance of the sample items in capturing the constructs, although the level of 'low' depends on the purpose of research (Churchill 1979). The alpha level should exceed .70 for an acceptable standard, but for the exploratory and the early stage of research Nunnally (1978) suggested an alpha of .50 to .60 is sufficient. Eliminating items with correlations near zero or increasing the number of items can be a way to push the alpha rating to an acceptable level (Cortina 1993).Table 6.13 illustrates the SPSS output of the alpha level; it shows that all constructs and their first order sub-constructs had an acceptable level of coefficient alpha for this stage of the research.

Table 6.13 Reliability Test Results

No.	Construct Name	Sub-constructs/First- order constructs	No. of items	Mean	Cronbach Alpha
1	**Vertical coordination**		12	3.86	0.63
		Coordination of work	3	3.79	0.40
		Formalization of transaction	3	3.35	0.59
		Contractual arrangement	3	4.67	0.71
2	**Price uncertainty**		6	5.39	0.64
3	**Competition**		3	4.57	0.71
4	**Environment**		2	5.75	0.74
5	**Transaction climate**		5	4.02	0.84
6	**Power**		3	3.51	0.64
7	**Inter-firm relationship strength**		13	3.90	0.71
		Mutual Investment	3	1.88	0.87
		Interdependence	4	3.79	0.52
		Trust	4	4.98	0.62
		Commitment	2	5.11	0.52
8	**Knowledge asset management**		14	4.10	0.88
		Knowledge acquisition and Learning	4	3.73	0.74
		Accessibility	2	4.66	0.70
		Shared meaning	2	3.50	0.58
		Knowledge Use	4	4.27	0.81
		Knowledge memory	2	4.59	0.72
9	**IOS use**		9	3.07	0.74
10	**SC performance**		7	5.03	0.76
		Customer-Facing	3	5.41	0.83
		Internal-Facing	4	4.74	0.51
11	**Competitiveness**		4	4.12	0.83

It is noticeable that almost all the multidimensional second order constructs, i.e., relationship strength, knowledge asset management, and SC performance (except the construct of ‘vertical coordination’ which had a score of 0.627) had an alpha higher than 0.70, although some of their sub-constructs had comparatively lower scores. Because many items were developed from scratch using the interview analysis from the qualitative field study, followed by the rigorous review of the expert panel that limited the number of items to only two or three in some first order constructs, the alpha scores of 0.50 to 0.60 were considered sufficient for the exploratory nature of the research at this stage.

Table 6.13 shows that the score of 0.40 for the first order construct ‘coordination of work’ under ‘vertical coordination’ did not meet the lowest acceptable limit. The SPSS output presented in Table 6.14 revealed that deleting the item CD 2 could have increased the score to 0.602. However because of the high face validity of the item to measure the construct (Nidumolu 1995), it was decided to retain the item for the final survey.

Table 6.14: Reliability Analysis for the Construct Coordination of Work

Item code	Measure	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CD1	We have high level of coordination on sales date, delivery times and other transactions with our major buyers/supplier	5.90	7.762	.268	.328
CD2	We have had investment in our company’s asset from our major buyers/suppliers	9.44	7.912	.145	.602
CD3	We often share information that affects our business with our major buyers/suppliers	7.43	5.533	.317	.136

Thus, from the findings of the pilot study it was concluded that the survey instruments were sufficiently sound for use as the final survey. As there was no major change likely to affect the collected data in the pilot study, it was decided to use the data in the total sample in the final survey for statistical analysis using confirmatory factor analysis.

6.4 Summary

This chapter has detailed the development of the questionnaire and the measures to test the hypotheses of the study that draw together the dependent and independent variables of the finalized supply chain performance model, as discussed in Chapter 5. The questionnaire (see Appendix 2) was designed targeting a completion time of 20 minutes through a telephone survey (using Computer Assisted Telephone Interviewing - CATI system) and having two different computerised versions with slight changes in the wording of some of the questions based on the primary role of a participant as a buyer or seller. Almost all of the questions were based on a seven-point Likert scale; except those used for demographic data which, principally, were descriptive in nature. Using CATI for data collection caused a major concern regarding the survey layout and design, logical structure and overall cognitive process of interpreting the questions and answering the questions. Therefore, a combination of different techniques for pretesting the questionnaire and the survey were applied: a three-stage process of pretesting by means of i) expert review, ii) cognitive interviews and, finally, iii) a pilot study. The first method involved reviewing the newly developed questionnaire by three professionally expert people while the second method involved conducting ten interviews with real respondents from the beef industry to gather the internal cognitive processes of respondents when answering the questions. Finally, a mini-version of the full-scale survey (pilot study) helped to examine the length, flow, response and reliability of the survey instrument leading to some changes to make it ready for the final survey.

Chapter 7

Data Analysis Using Structural Equation Modeling[*]

7. 1 Introduction

This chapter presents details of the survey data analysis from testing of both the measurement and structural parts of the research model, and reports on the outcomes of hypotheses of the study that were described in Chapter 5. Data were collected through the telephone survey of 315 firms and tested using the partial least square (PLS) based structural equation modelling – a confirmatory second-generation multivariate analysis technique.

First, the confirmatory factor analysis procedure in PLS was used to test the contribution of each scale item to represent a construct and its reliability in estimating relationship with other constructs; then, a detailed testing of the validity of second-order construct model is presented. Finally, the test of the structural model, hypothesized relationships and the associated statistical power of the model has been explained.

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[*] Part of this chapter has been presented at the following conferences:

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Managing knowledge asset for competitiveness in Australian agri-food supply chain: the antecedents and consequences. Accepted as a full paper for presentation in the International Conference on Computer and Information Technology (ICCIT) 2010, 23-25 December. Dhaka.

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Knowledge asset and inter-organizational relationship in the performance of Australian beef supply chain, in *Proceedings of the Fourteenth Pacific-Asia Conference on Information Systems (PACIS)*, 9-12 July, 2010, Taipei, Taiwan.

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Impact of Inter-Organizational Relational Mechanism on Firm Performance: Some Exploratory Findings in Australian Agri-Food Industry Supply Chain, , in *Proceedings of the* Oxford Business and Economics Conference (OBEC), 28-30 June, 2010, St Hugh's College, Oxford University, Oxford.

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Inter-firm relationships and performance factors in the Australian beef supply chain: Implications for the Stakeholders, in *Proceedings of the Australian Agricultural and Resource Economic Society (AARES) National conference,* 10-12 February, 2010, Adelaide.

7.2 Survey Procedure

As described in detail in Chapter 3, data were collected through a telephone survey by contracting a professional survey centre from Edith Cowan University Perth, Western Australia. Telephone surveys (as discussed in detail in Section 3.3.3.2) have the advantage of collecting complete and accurate data by being more efficient in time and resources but have a disadvantage that respondents cannot see the scale and have limited ability to recall response categories (Robson 2002; Zikmund *et al.* 2007). To overcome the limitation, a seven point Likert scale ranging from 'strongly disagree to strongly agree' and 'never to always' was used in the study without mentioning any mid-point (details are discussed in Section 6.2) as the study found more lower scores and fewer higher scores in telephone surveys in Australia when a mid-point was mentioned (Dawes 2001).

It is important to note that given the available funds, targeted respondents and objectives of the research, the survey covered the beef industry of the states of Western Australia (WA) and Queensland (QLD) among the seven states of Australia and were used to generalize the results to the overall Australian beef industry (details are provided in Section 3.3.3); as there were little difference in industry structure among the states except that the amount of beef production and export where QLD ranked first and WA ranked fourth (MLA, 2008a). While the main focus of this study was on WA, much of the national industry information was linked to QLD. For a proportionate allocation of the sample respondents in each of the two states, the respondents were categorized as beef-cattle producers, processors/exporters, retailers/wholesalers and input suppliers. Using the method of stratified random sampling, a quota system was then applied to carry out the survey so that enough total samples are obtained from both the states to conduct statistical analysis. A minimum of 30 and a maximum of 100 responses were targeted for each of the three main categories in each of the two states of WA and QLD. A list of addresses of around three thousand firms and phone numbers from WA and QLD was generated, targeting one response per firm with the person holding a high position in the supply chain/distribution; the list was developed through the help and proper agreement of data security with government and private organizations. The final sample included all the available beef processors, beef producers with more than 100 head of cattle, and a larger number of retailers and input suppliers.

The survey was administered during September and October, 2009. The CATI (Computer Aided Telephone Interviewing-discussed in Section 3.3.3.2) system was used, which made administering different versions of the questionnaire to different categories of people very easy. The software also managed the sample records and released them randomly, administered appointments, and saved interview data. If the person who was being called was not available at that time, up to three call backs were made to contact them to make an appointment. A proportion of the interviews were monitored by a supervisor to ensure the interviewers followed their instructions closely; a normal part of the quality control guidelines. Thus, a total of 315 valid responses from the beef industries in WA and QLD in Australia were eventually obtained.

7.3 Demographic Information of the Survey

Demographic data can help to paint a more accurate picture of the characteristics of the survey as demonstrated in the following result. Of the 315 survey responses, Table 7.1 shows that most of the participant firms in WA are producers/farmers (49%) and in QLD are processors (41%). QLD dominates the processing sector with large export works and around 47% of the Australian beef cattle herd. In WA, effectively, the state has four major processors of sheep and cattle including the largest beef processor - Harvey Beef (WA Farmers 2009; WY and Associates 2009). Among the four major players in the retailing channel, this study included Woolworths and Coles, who have a combined market share of more than 50%, IGA and independent butchers. Table 7.1 about respondents' groups, shows that the retailers and wholesalers in WA comprised 23.6% and in QLD 20.7% of respondents. In terms of the specialized beef producers group, Table 7.2 presents several major differences – 49% of the QLD producers compared to 6% of WA producers have a herd size greater than 1600. The result indicates that in WA the beef industry is made up of small-to-medium beef producers while QLD is made up of medium-to-large producers.

Table 7.1 Respondent Categories

Groups		States		Total
		WA	QLD	
Beef Cattle Producer/Farmer/Feedlotters	Count	81	55	136
	%	49.1	36.7	43.2
Beef meat Processor/Abattoir/Exporter	Count	42	62	104
	%	25.5	41.3	33.0
Beef Retailer/Wholesaler	Count	39	31	70
	%	23.6	20.7	22.2
Input Supplier, e.g., feed, livestock, transport	Count	3	2	5
	%	1.8	1.3	1.6
Total	Count	165	150	315
	%	100.0	100.0	100.0

Table 7.2 Percentage of specialised beef producers according to herd size

Group	Beef cattle numbers	States		Total
		WA	QLD	
Small	100–400 head	72.8	23.6	52.9
Medium	401–800 head	13.6	10.9	12.5
	801–1600 head	7.4	16.4	11.0
Large	Greater than 1600	6.2	49.1	23.5
	Total	100.0	100.0	100.0

Major differences are indicated by use of coloured shading.

The demographic data found some typical characteristics in Australian agribusiness. Traditionally, agricultural business in Australia has been managed and owned by families and involved in a capital investment between $1 million and $5 million taking account of all assets (Australian Agribusiness Group 2008). Table 7.3 shows that in both WA and QLD, most of the respondents (78%) were the owner of the firm, indicating a family-owned business, while the rest of the survey participants were working as supply chain/logistic managers (10.8%) and executives (10.2 %) of the firm.

Table 7.3 Respondent Position in the Firm

	States		Total
	WA	QLD	
Owner	77.6	78.0	77.8
Supply Chain Manager	10.9%	10.7%	10.8
Executive	9.7%	10.7%	10.2%
Other	1.8%	.7%	1.3%
Total	100.0%	100.0%	100.0%

Agricultural firms usually are characterized as SMEs. In Australia, the size of a business is defined as having 1-19 employees for a small size, 20-199 for a medium size, and 200 or more people for a large business (ABS 2002, Fair Work Act 2009). But, it is argued that the size-based definition based on the number of employees should not be used for the agricultural sector as a large scale agribusiness operation can be conducted with relatively few or no permanent employees. Therefore, a small business should be defined by the estimated value of the agricultural operation (EVAO) within $22,500 - $400,000 (ABS 2002), which was also identified in the current survey. Because the data found evidence that some firms with only 2-5 employees had a $500,000 to $5 million turnover. Tables 7.4 and 7.5 present the size of the surveyed firms based on the number of employees and associated amount of revenue. Although Table 7.4 did not show any significant difference between WA and QLD, a major difference was noted in the small-to-medium firms in Table 7.5 where QLD firms, compared to WA, are well ahead in annual average revenue. The results show that more than 85% of respondent firms in the beef industry fall within the definition of a SME, while among them 53% had less than $1 million of average annual turnover, 26% had $1-5 million, and 13% had more than $10 million in turnover.

Table 7.4 Size of Firm Based on Employees

Group	Number of employees	States		Total
		WA	QLD	
Small	1– 19	78.8	79.3%	79.0%
Medium	10–199	14.5%	16.7%	15.6%
Large	200 or more	6.7%	4.0%	5.4%
		100.0%	100.0%	100.0%

Table 7.5 Size of Firm Based on Revenue

Group	Group	States		Total
		WA	QLD	
Small	Less than 1 million	61.8%	44.0%	53.3%
Medium	1–5 million	17.6%	36.0%	26.3%
	6–10 million	3.0%	6.7%	4.8%
Large	More than 10 million	15.8%	10.7%	13.3%
	Refused	1.8%	2.6%	2.3%
	Total	100.0%	100.0%	100.0%

In terms of growth, Table 7.6 shows a better performance by QLD producers, processors and retailers. It is important to note that 44% of the WA producers, compared to 12% of QLD producers, said that they are just surviving, shrinking or going broke/selling soon. Thus the results indicate a major profitability problem among the upstream producers in the WA beef supply chain. The survey participants also were asked about their targeted income. It was interesting to find that most producers were expecting a more than 30 percent increase in income from the same resource base; some of them expected to nearly double their income, compared to processors and retailers expecting a 10 to 30 percent increase (some of them expect a 50 percent domestic and a 50 percent export increase). In fact, some producers were looking at doubling their income and expressed concern about their market uncertainly and isolation from the supply chain, such as one of the farmers who commented: *Our market share dictates our income. I would like to see it grow, and therefore we need more market certainty and better prices. Most of the time we accept what we get, we are not price makers, we are price takers.*

Table 7.6 Growth Status of the Firm

	Groups of SC participants						Total in WA	Total in QLD
	WA_ Producer	Qld_ producers	WA_ Processor	Qld_ Processor	WA_ Retailer	Qld_ Retailer		
Growing	13.4%	40.8%	36.4%	52.3%	31.3%	32.4%	23.0%	43.3%
Matured	14.6%	18.4%	27.3%	9.2%	10.4%	17.6%	16.4%	14.0%
Established and trying to get bigger	28.0%	28.6%	30.3%	32.3%	33.3%	35.3%	30.3%	32.0%
Shrinking	11.0%		3.0%		8.3%	5.9%	8.5%	1.3%

Just surviving	22.0%	8.2%	3.0%	6.2%	14.6%	8.8%	15.8%	8.0%
Winding up/selling/going broke	11.0%	4.1%			2.1%		6.1%	1.3%

7.4 Selection of Estimation Method

As described in Chapter 3, the current study used Structural Equation Modelling (SEM) that allows development of a model in both the measurement (relationship between latent variables and their indicators) and structural parts (relationship between the latent variables). SEM also was chosen because of its ability to represent unobservable latent constructs estimating relationships with its observed variables (indicators), the measurement errors for the observed variables, and the use of these variables in a hierarchical multi-dimensional construct. There are two separate approaches in SEM – i) COV-SEM such as LISRELL, AMOS, EQS, and ii) PLS-SEM such as PLS-PC, PLS graph, smart-PLS, which are complementary and should be chosen based on the objective and conceptual model of the study. A detailed description and difference between the two approaches was given in Chapter 3.

7.4.1 Use of Partial Least Square (PLS)

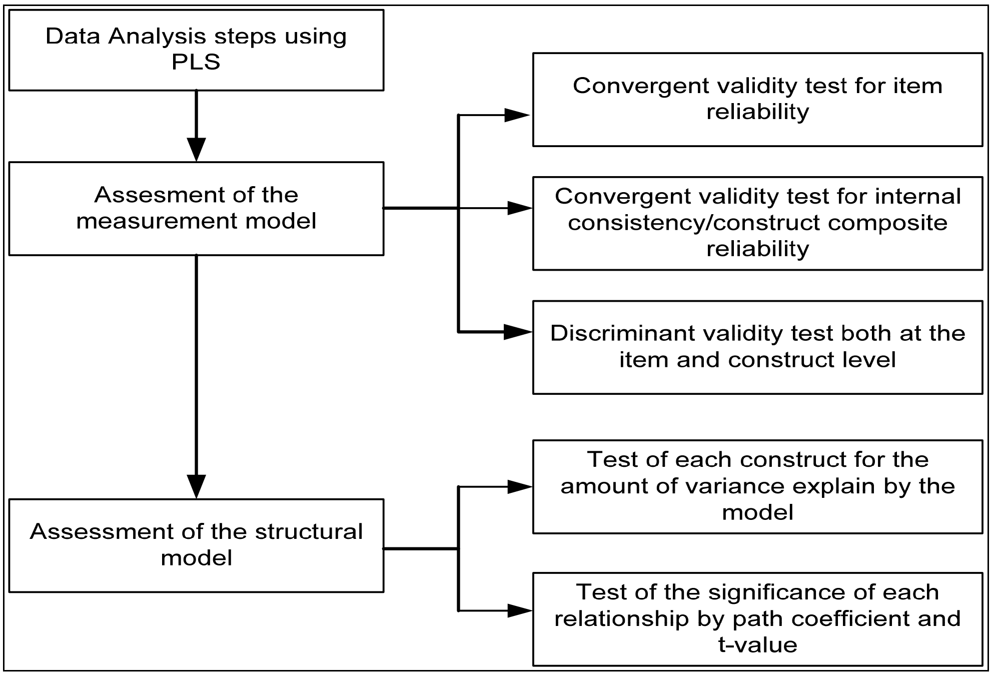
Partial Least Squares based SEM (PLS-SEM), a confirmatory second-generation multivariate analysis tool, was used in the study to test the hypotheses in the research model as opposed to the covariance based (COV-SEM) approach (such as LISREL, EQS, AMOS). PLS was chosen because of the predictive nature of the study, the ability to model complex composite multidimensional constructs with many different dimensions and paths, to handle formative measures and, finally, to deal with a small to medium sample size (Chin 1998b; Chin and Gopal 1995; Anderson and Gerbing 1988; Fornell and Bookstein 1982; Barclay *et al,* 1995, Wold 1985). As a components-based structural equation modelling technique, PLS is similar to regression but simultaneously models the structural paths (i.e., theoretical relationships among latent variables) and measurement paths (i.e., relationships between a latent variable and its indicators). Unlike COV-SEM, it tests the strength of individual component relationships to show the significance of individual paths rather than the overall fit of a proposed model for observed covariance amongst the variables (Johnston *et al*. 2004). PLS focuses on maximizing the variance of the dependent variables explained by the independent variables instead of reproducing the empirical covariance matrix, while using iterative estimation techniques consisting of a series of ordinary least squares analysis (Chin, Marcolin and Newsted 1996; Haenlein and Kaplan 2004; Wold 1982). Therefore, covariance fit is not needed as the objective of PLS is not testing a theory but to model the predictive power with some antecedent constructs to an endogenous construct. Therefore, it provides measures like factor loading, R^2 and the significance of relationships among constructs, which are more indicative of how well a model is performing. It also calculates and shows the output of all the indirect and direct effects to establish the relative importance of antecedent constructs.

Reasons for using PLS for data analysis include the ability to estimate formative measures, the ability to model composite higher-order constructs and the ability to build a complex framework of multi-block analysis for a hierarchical model (Wetzel *et al.* 2009; Rai, Patnayakuni and Seth 2006), as discussed in Chapter 5. In this study, three composite second-order constructs with formative measures were used in the research model. Chin (1998b) notes that using LISRELL/AMOS for formative indicators becomes problematic as it attempts to account for all the covariances among the measures because of the statistical algorithm that assumes the correlations among indicators for a particular latent variable are caused by that latent variable; therefore, all items in the covariance-based SEM must be modelled as reflective. Although some authors suggest use of at least two paths emanating from a formative construct or to use at least two reflective measures to avoid identification problems (inability of the proposed model to generate unique estimates) of formative constructs when used in covariance based SEM (Jarvis, MacKenzie and Podsakoff 2003; Mackenzie *et al.* 2005), the suggestion is still under debate. But as an iterative combination of principal component analysis consisting of a series of ordinary least squares (OLS) simple and multiple regressions, PLS does not have any identification or factor indeterminacy problem. It estimates the latent variables as exact linear combinations of the observed measures and, thereby, avoids factor indeterminacy problems by giving an exact definition of component scores (Anderson and Gerbing 1988; Chin, Marcolin and Newsted 1996).

PLS supports variance analysis (R^2) and is generally recommended for predictive research where the emphasis is on causal-predictive analysis and theory development (Anderson and Gerbing, 1988). A main focus in this study is to develop a supply chain performance model by drawing the associated antecedents and consequences in the agri-food domain in Australian industry. Using the theoretical lens from RBV/KBV and TCE, the findings of the qualitative field study suggest antecedent factors such as ‘knowledge asset management’, IOS use’, and ‘inter-firm relationships strength’ have causal relationships with supply chain performance, which also have consequences in achieving overall industry competitiveness. Thus, based on the survey empirical data, the predictive power of the performance model investigated the significant causal relationships associated with the supply chain performance and competiveness in the beef industry. Had the study aimed to confirm the application of TCE/RBV in the research domain, it would have been more suitable to use LISREL or AMOS.

PLS had two stages of analysis (Barclay, Higgins and Thompson 1995; Santosa, Wei and Chan 2005) as illustrated in Figure 7.1. First, the measurement model is estimated showing statistics (i.e., loadings) that assess the validity and reliability of variables and their respective constructs. Second, the results for the structural model are reported showing the relationships (i.e., path coefficients) between the constructs and the explained variance. Thus, PLS shows which assumed predictors have substantive links to outcomes by estimating the relative strength of relationships using the path loading of the predictors. Using the R^2, it also can be judged to what extent variation in one set of variables might help explain variance in another variable of interest. Figure 7.1 illustrates the PLS data analysis procedure in the study.

Figure 7.1 Required Steps of Data Analysis in PLS



7.4.2 Data Examination

Examining the data is essential before any application of a multivariate technique in order to determine the reasonable grounds of statistical analysis and to avoid erroneous calculations (Alerck and Settle, 1995; Hair *et al*. 1998). It is better to check the nature of variables, their distributional properties and the pattern of missing values and normality of the data for any assumptions in the multivariate analysis.

The research model used a total of 81 items which were checked for any potential errors in the data set. The items were used to measure three formative second-order constructs (molar construct), one reflective second-order construct (molecular construct) and 22 reflective constructs among which 15 were used as first order to form respective second-order constructs (detailed in Chapter 5). All the minimum and maximum values of the item scales' mean and standard deviations and a number of missing values were checked for any disorder or superfluous records. Thus, although a total of 319 sample responses were collected, 4 responses were found unusable and deleted because of excessive missing values, giving a total of 315 valid responses.

For the treatment of missing data, an expectation-maximization (EM) algorithm based on maximum likelihood estimation in SPSS 17 was used to determine whether the missing values were missing completely at random (MCAR) or missing at random (MAR); details as in Chapter 3. Little's MCAR test was significant indicating that the data were MAR because most of the missing values were randomly distributed to some specific items. While it was safe to use any imputation or replacement technique for the MCAR data, MAR data required more stringent treatment such as multiple imputation or estimated mean (EM) from the EM algorithm (Little and Schenker 1995; Pickles 2005). Therefore, all the missing values were imputed using estimated means (EM).

The assumption of multivariate normality was tested using Kolmogorov-Smirnov's normality test, although PLS analysis does not require a normally distributed dataset (Chin, Marcolin and Newsted 2003). The test showed that distribution characteristics are normal. Skewness and Kurtosis values of the individual items fell within the acceptable range (±2). Thus, in this study the multivariate normality assumptions corresponded to the normal distribution of data.

7.4.3 Sample Size

As sample size has a substantial impact in achieving statistical significance, Hair et al. (1998) suggested that in any analysis when sample sizes exceed 200 to 300 respondents, the result can ensure practical significance due to the increased statistical power. For SEM analysis, studies have suggested a minimum sample size of 150 "to obtain parameter estimates that have standard errors small enough to be of practical use" (Anderson and Gerbing 1988, p. 415). The advantage of PLS is that it can be used even for a very small sample size in model estimation as well as testing (Barclay, Higgins and Thompson 1995; Haenlein and Kaplan 2004; Fornell and Bookstein 1982). Lohmololler (1982) presents two examples of PLS; one model with 27 indicators was appropriately estimated using only 10 data sets while another with 96 indicators and 26 constructs was estimated using 100 cases. Chin and Newsted (1999) indicated that a sample size as low as 50 can be used for the results in PLS to be interpreted.

However, the literature shows that the preferred rule for sample size in PLS depends on the number of indicators of the most complex construct or the number of predictors for an endogenous construct (Barclay, Higgins and Thompson 1995, Gefen, Straub and Boudreau 2000). The most preferred rule of thumb, as recommended by Barclay, Higgins and Thompson (1995) is that sample size should equal ten times either the number of indicators of the most complex formative latent construct or ten times the largest number of independent variables impacting on a dependent variable, whichever is greater.

According to the rule, the largest number of independent variables impacting on the dependent variables in this study was 6; the six constructs of knowledge asset management, IOS use, inter-firm relationship strength, negotiation power, environmental management and price uncertainty as independent variables influencing SC Performance. Thus, the required minimum sample size is 10 x 6 = 60. On the other hand, the model used three second-order formative constructs with the most complex one, inter-firm relationship strength, comprising 5 first-order constructs using a total of 14 items. This demonstrates a minimum sample requirement of 10 x 14 = 140. Thus the sample 315 obtained from the telephone interview in this study was considered sufficient for a robust PLS model, as indicated from the above discussion.

7.5 Model Assessment

The two required steps for data analysis in PLS, as stated earlier, were conducted using PLS-Graph version 3.0 (see Quaddus and Hofmeyer 2007; Santosa, Wei and Chin, 2005, Barclay, Higgins and Thompson, 1995, Agarwal and Karahanna 2000; Johnston, *et al.* 2004). It involved

i. assessment of the measurement or outer model describing the relationships between latent constructs and their manifest indicators, and
ii. assessment of the structural or inner model describing the hypothesized relationships between latent construct.

The re-sampling technique in PLS such as bootstrap (Efron and Tibshirani 1993) or jackknife (Fornell and Barclay 1983) output can be used for the analysis and assessment of both the measurement and structural parts. The procedures can be used for CFA (Confirmatory Factor Analysis) and t-test results for all constructs. This study used bootstrapping as the preferable method because "jackknifing is considered both less efficient and an approximation to the bootstrap" (Chin, Marcolin and Newsted 2003 p. 212). Moreover, bootstrap in PLS-Graph can also generate AVEs (Average Variance Extracted). To generate the estimation of the PLS path model or hypothesized relationships, bootstrapping produces estimates based on a specific number of sub-sample or observations (m - bootstrap sample size) as defined by the researcher, which are chosen randomly from the original sample (n - original sample size). Although there is no consensus regarding the size of a bootstrap sample, a minimum recommended number of sub-sample (r) is 100, while studies tend to choose bootstrap sample size equal to original sample size (m = n)(Andreev, 2009). Although using m = n in bootstrapping allows capturing all the options presented by the original sample, it is not necessary to set the sub-samples equally because an optimal 'm' could be less than 'n' when the sample size is large (Andreev *et al.* 2009; Bickel and Sakov, 2008; Chernick, 2008). However, a minimum of 200 resamples can provide reasonable estimates (Chin, 2001).

This study used an equal number of sub-samples (m=315, n=315) to perform bootstrapping for computing parameter means, indicator loadings, indicator weights, standard errors and the significance of path coefficients. This approach has been consistent with the recommended practices and has been used substantially in prior IS studies (Barclay, Higgins and Thompson, 1995; Chin and Gopal 1995; Lohmoeller, 1984; Rai, Patnayakuni and Seth 2006; Santosa, Wei and Chin 2005; Quaddus and Hofmeyer 2007)

7.5.1 Assessment of the Measurement Model (Outer Model)

The psychometric properties of the measurement scales in PLS can be assessed using the item loading, composite reliability and discriminant validity. Therefore, in assessing the PLS measurement model, studies refer to three sub-steps of PLS confirmatory factor analysis for checking the convergent and discriminant validity of the measures. These steps are to check whether the measurement items appropriately reflect the constructs and whether a given construct and its items differ from the other constructs and their items. Convergent validity refers to whether the indicators of a latent construct that are theoretically related, in fact are observed to be related (Trochim 2006). The three sub-steps are:

i. reliability of the individual item that makes up the measure,
ii. composite reliability or internal consistency of the item as a group (comparable to Cronbach's α), and
iii. discriminant validity which is the average variance extracted (AVE) from the constructs by each of the items (Barcly, Higgins and Thompson 1995; Fornell and Larcker 1981).

The above steps measure convergent validity at different levels; the first operates at the indicator level, while the latter two occur at the construct level. It is important to note that testing of reliability, internal consistency, and average variance extracted (AVE) are required for the reflective constructs where measurement items are driven by the construct and should covary with one another (Petter, Straub and Rai 2007). As reflective items are measuring the same phenomenon, they should be unidimensional with positive correlations between the measures (Bollen and lennox 1991). On the other hand, formative constructs are driven by their indicator items that are not strongly correlated and can be either negative or positive, are multidimensional and cause the construct to exist. Therefore, internal consistency and reliability of the formative construct items are not important, although they are perfectly suitable to study the cause and effect on other constructs by bringing diverse and disparate indicators into a holistic single construct (Barclay, Higgins and Thompson 1995; Cenfetelli and Basselier 2009; Coltman *et al*. 2008; Chin 1998a 1998b; Gefen, Straub and Boudreau 2000; Diamantopoulos and Winklhofer 2001; Nunnally and Bernstein, 1994; Santosa, Wei and Chan 2005, Petter, Straub and Rai 2007).

The use of loadings for formative indicators is misleading (Chin 1998a) since indicators may represent different dimensions and are assumed not to be correlated, while internal consistency is not important because two variables that might even be negatively related can both serve as meaningful indicators in a formative construct (Santosa, Wei and Chan 2005; Nunnally and Bernstein 1994). Formative indicators "are not used to account for observed variances in the outer model but rather to minimize residuals in the structural relationship" (Peter, Straub and Rai 2007, p. 626). Therefore, AVE also is not important. Since, there is no simple, easy and universally accepted criteria to assess the reliability of formative constructs, studies have suggested using the weights of the formative indicators to provide information on relative importance and the contribution of the indicators in forming the latent construct (Barclay, Higgins and Thompson 1995; Cenfetelli and Basselier 2009; Coltman *et al*. 2008).

However, the model operationalization in this study primarily relied on reflective measures, while formative measures were used only for creating the three second-order constructs of vertical coordination, inter-firm relationship strength and SC performance. The second-order constructs were measured creating linear composites of the items used to measure each of the first-order constructs/subcontracts (Rai, Patnayakuni and Seth 2006). While all the first order items are reflective, the linear composite scores of the items were used as formative indicators for the second-order constructs. Factor scores derived from SPSS were used to compute the linear composites scores (Hair et al. 1995). The second-order constructs were used mainly to explain the interrelations with their lower-order constructs, and were expected to fully mediate the lower-order relationship to other hypothesized relationships with other dependent constructs in the model. A detailed description of the decision to use formative and reflective higher order constructs in the research model was given in Chapter 5.

7.5.1.1 Item reliability

Reflective measures

The individual item reliability in PLS, as part of the convergence check of each of the reflective manifest variables with the associated latent variable, was assessed by examining the loading (λ) or simple correlations of the measures with their respective construct. The initial model was first tested with 81 observed variables used to create 11 constructs, and 15 sub-constructs.

The commonly used threshold value for acceptable item reliability is $\lambda \geq 0.7$, which implies more than 50 percent shared variance between the construct and its measures (Barclay, Higgins and Thompson 1995; Fornell, and Bookstein 1982). However, some studies have suggested that it is not an absolute standard; a lower value such as 0.5-0.6 is acceptable when the research is exploratory (Hair *et al.* 1998; Hanlon 2001; Hinkin 1995; Jackson 2008; Quaddus and Holfmyer 2007). After examining the survey data, it was found that maintaining the 0.7 reliability standard would be difficult, especially for those constructs where new items developed from the content analysis of field interviews were used. Thus, considering the exploratory nature of the study, a minimum value of 0.6 ($\lambda \geq 0.6$) was adopted as the standard to accept the reliability of individual items. The item loadings for the full model are detailed in Table 7.7 below.

Table 7.7 Assessment of Item Reliability

Construct Name	Item Name	Loading	t-value	Construct Name	Item Name	Loading	t-value
Competition Intensity (CP)	CP1	0.750	15.922	**IOS USE (IOS)**	IS1	0.846	41.082
	CP2	0.809	23.128		IS2	0.779	29.696
	CP3	0.640	12.197		IS4	0.711	20.530
Environmental Management (EV)	EV1S	0.876	17.442		IS5A	0.677	18.143
	EV2S	0.796	12.294		IS5B	0.800	30.857
Vertical Coordination (VC)*		N/A			IS5C	0.788	30.000
Coordination of Work	CD1	0.820	13.047		IS5D	0.748	26.077
	CD3	0.785	12.507		IS5E	0.779	26.989
Formalization of Transaction (FT)	FT2	0.670	15.949	**Inter-firm Relationship Strength (RS)***		N/A	
	FT2a	0.699	19.380	**Mutual Investment (MI)**	MI1	0.798	26.517
	FT3	0.768	30.051		MI2	0.892	53.201
	FT3a	0.776	40.807		MI3	0.872	45.222
Contractual Arrangement	CA1	0.866	46.643	**Trust (TR)**	TR1	0.562	7.940
	CA2	0.872	59.135		TR1a	0.688	8.211
	CA3	0.834	42.617		TR2	0.770	10.240
Transaction Climate (TC)	TC1	0.821	30.911		TR2a	0.750	10.289
	TC1a	0.835	35.684	**Contract Choice (CN)**	CN1	0.462	3.509
	TC2	0.808	33.640		CN2	0.818	7.553
	TC3	0.619	9.759	**Commitment (CM)**	CM1	0.921	14.461
	TC3a	0.603	9.668		CM2	0.910	13.909
Knowledge Asset Management (KAM)**	Shared Meaning (SM)	0.777	31.774	**Interdependence (IP)**	IP2	0.943	14.292
	Usage (US)	0.873	64.585		IP2a	0.901	13.549
	Memory(MM)	0.819	38.448	**Price Uncertainty (PU)**	PU4	0.756	12.722
	Accessibility (AC)	0.674	15.241		PU5	0.764	12.770
	Acquisition and Learning (AL)	0.790	34.723		PU6	0.733	12.831
Acquisition and Learning(AL)	AL1	0.712	18.070	**Negotiation Power (NP)**	Np1	0.882	54.949
	AL2	0.820	33.950		Np3	0.826	28.370
	AL3	0.839	41.333	**SC Performance (PR)***			
	AL4	0.846	48.452	**Customer-Facing (CF)**	CF1	0.870	52.130
Accessibility (AC)	AC1	0.926	14.588		CF2	0.874	44.148
	AC2	0.897	14.176		CF3	0.805	26.542
Memory (MM)	MM1	0.895	14.490	**Internal-Facing (IF)**	IF1	0.590	8.345
	MM2	0.877	14.058		IF3	0.733	17.070
Shared Meaning (SM)	SM1	0.845	13.944		IF4	0.824	39.466
	SM2	0.850	14.093	**Competitiveness (CMP)**	CMP1	0.785	30.560
Usage (US)	US1	0.839	40.391		CMP2	0.808	27.379
	US2	0.862	58.750		CMP3	0.790	28.373
	US3	0.771	22.876		CMP4	0.814	39.397
	US4	0.840	43.624				

*2nd order formative construct, therefore values are not applicable, ** 2nd-order reflective construct

The results of the initial model showed that 14 items failed to meet the adopted reliability standard. The reflective constructs items CD2, FT1, FT1a, IOS3; NP2; IP1, IP1A, CN1, CN3; PU1, PU2, PU3, TR1 and IF2 had a loading of less than 0.6. Before removing the low loading items, some criteria were used for the final decision of deletion such as whether the items were a good representation of the domain of each construct and whether multicolinearity and multidimensionality was the cause of the weak loading (Cenfetelli and Bassellier 2009; Hanlon 2001; Nunnally 1978; Petter, Straub and Rai 2007). The subsequent test of multicollinearity using bivariate correlation and VIF tests ruled out the possibility of the existence of multicollinearity and multi-dimensionality.

Judgment was used then by reviewing the low loading items against the questionnaire, as well as with the prior literature (Kerlinger 1986) for a decision as to whether the deletion would neither harm the content validity of a construct nor diminish any predictive power of the model (Hinkin 1995, Nunnaly 1978). It was found that some of the new items that measured vertical coordination, relationship strength and SC performance in multidimensional first-order constructs, could not meet the standard which is very common when new scales are developed. As the objective in the study was to test the predictive power of these factors on supply chain performance and competitiveness, not to refine the scale by testing and re-testing, it was decided to delete 12 low loading items from any further calculation. Moreover, it was found that the deletion improved the reliability and validity of the constructs.

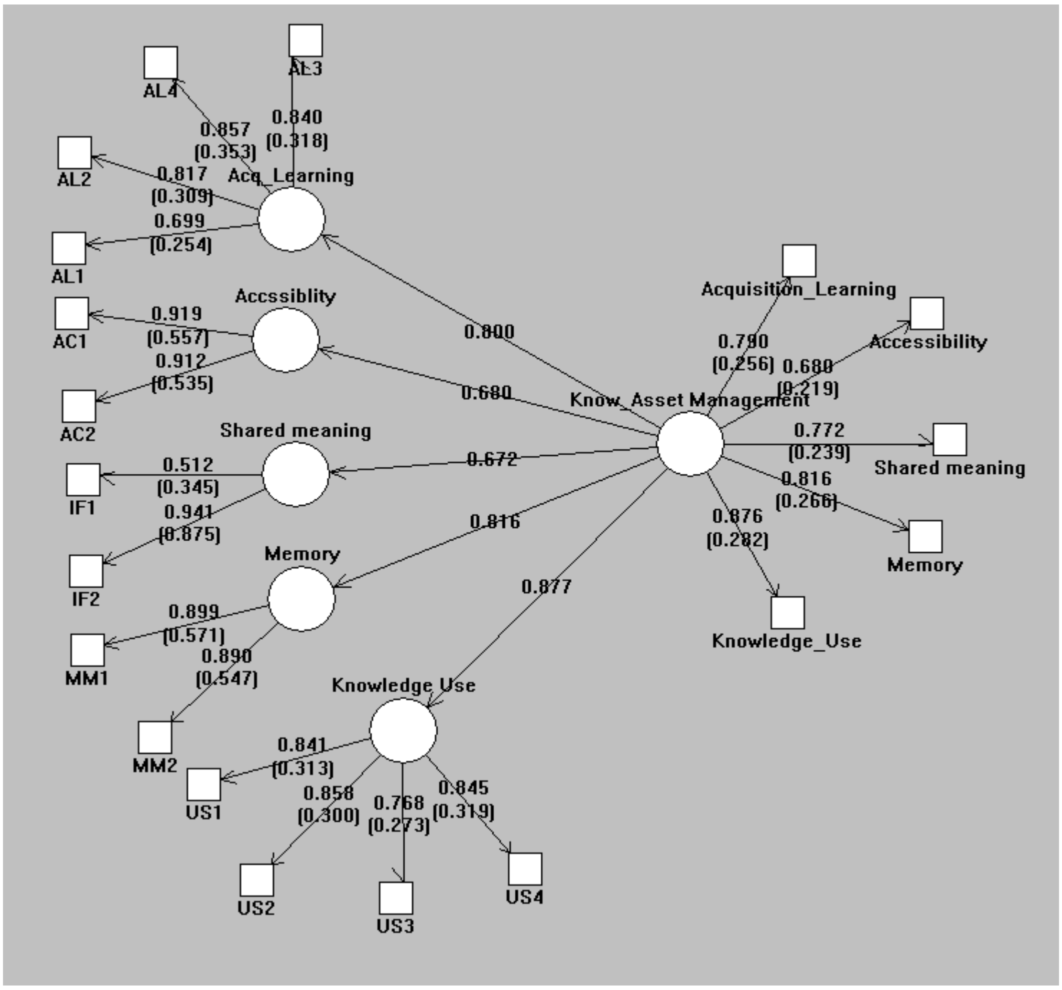
It was decided to keep two questionable loadings; viz., TR1 (0.5619) and CN1 (0.4617). The first one was close to 0.6 and literature suggested that the item was important to capture the content of the construct 'trust' and had a significant influence in predicting supply chain competitiveness. Besides, it was determined that keeping the item would not harm the other measures of convergent and discriminant validity of the construct, but instead would improve its content validity and predictive power.

The decision to keep CN1 was made so as to maintain the more important rule of having at least two items per construct, although the sub-construct 'contract choice' was developed using three items from the study of Schulze, Spiller, and Theuvsen (2006) and Szabo and Barbos (2006) where the items contributed significantly in measuring the importance of contracts in agribusiness. But in this study, two of the items (CN1 and CN3) failed to achieve the required loading; perhaps because of the different context of the study. After examining the value of the items in contributing the domain of the construct, the researcher decided to keep CN1 at this stage.

The revised model with the remaining 69 items was re-run in PLS and showed the reliability of all items exceeded the 0.6 reliability criterion. Given the fraction of deletions, the result was quite impressive since most scales are developed utilizing a particular theoretical and research context of the study that was distinct from those in which the items were first developed and used (Barclay, Higgins, and Thompson 1995). The theoretical frameworks also were found very reliable to develop constructs such as vertical coordination, price uncertainty, negotiation power, IOS use and competitiveness, because the item loadings ranged from 0.67 to 0.89, which was quite adequate.

It is important to note here that the construct knowledge asset management (KAM) was a higher level of abstraction and was created as a second order reflective multidimensional construct using linear composites of the items (Rai, Patnayakuni and Seth 2006) from its first order constructs (molecular approach as detailed in Chapter 5). Factor scores were used to compute linear composite scores for each of the first order constructs and used as reflective indicators for the second-order constructs (Hair *et al.* 1995; Rai, Patnayakuni and Seth 2006). Table 7.7 showed that all the items loaded above the threshold level. The graphical result of modelling KAM as second-order reflective construct is given in Figure 7.2. In the figure, the value above each path from latent variable *circles* to item *boxes* shows the item loading. The value below each path (in brackets) is the item weight. The loadings indicate that all items posited to form the given first-order constructs had strong correlations with the corresponding second-order constructs.

Figure 7.2 Loadings of Reflective Second-Order Construct Model in PLS - Knowledge Asset Management (KAM).



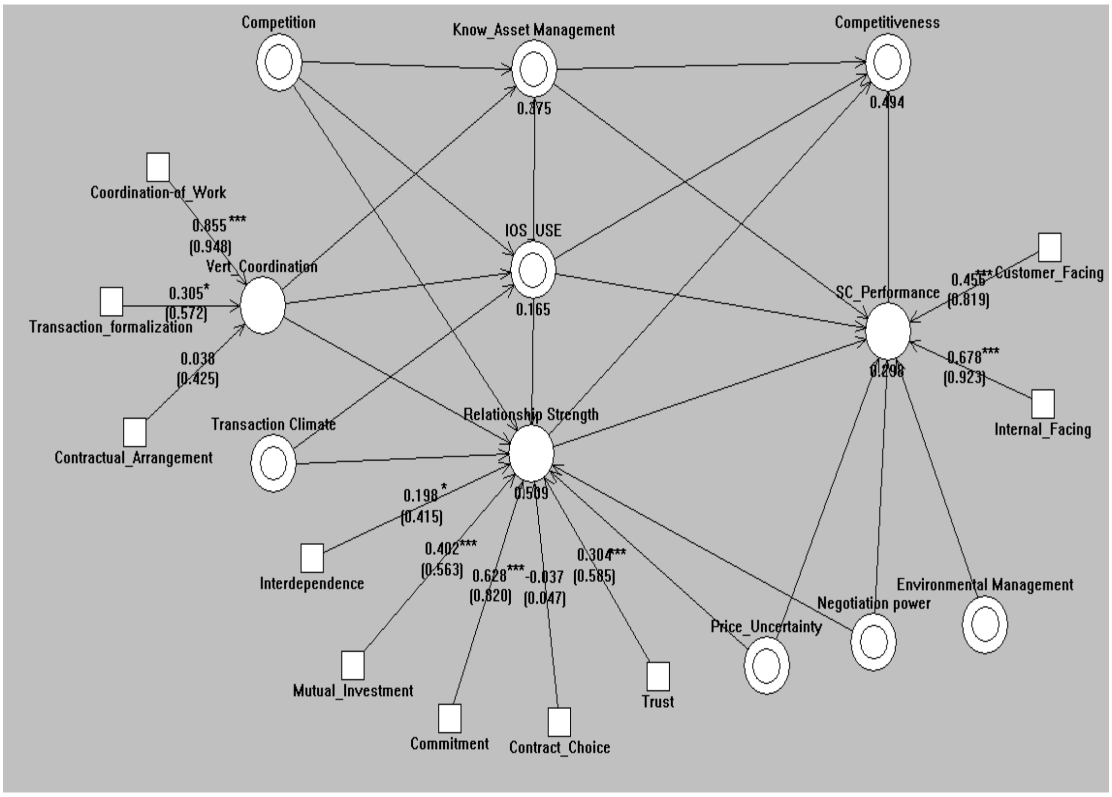
Formative measures

As discussed in Chapter 6, the research model for this study used three formative second-order constructs of vertical coordination, inter-firm relationship strength and SC performance by modelling the paths from first-order to the higher order constructs in a molar model (Chin and Gopal 1995; Chin 1998b; Edwards 2001, Pavlou 2006). The main purpose was to meet the study objectives by checking the relative weight and contribution of each of the first-order elements to its second-order constructs and thus their mediated impact in the supply chain performance model. Moreover, it was argued that formative indicators are used to establish the existence of the latent construct (Cenfetelli and Bassellier 2009; Chin *et al.* 1998b); a detail discussion of the development of the formative model was provided in Chapter 5.

To measure the second-order constructs, the linear composites of the items measuring each first-order construct was used as a formative indicator. Factor scores (such as the PLS latent variable score) or multivariate means based on the summated mean of the items can be used to compute the linear composites and is a recommended practice when new measures are developed and transferability required (Rai, Patnayakuni and Seth, 2006, Hair *et al.* 1995). The current study used principal components factor analysis to compute the first-order factor scores. The graphical results, in Figure 7.3 below, show the extraction of the formative weight of the second-order construct model in PLS.

For the formative second order constructs vertical coordination, inter-firm relationship strength and SC performance, the value above each path from an item (in boxes - representing each first order construct) to a latent variable (in circles) is the beta weight, while the values within the bracket are item loadings. Because the interpretation of weights is similar to beta coefficients in a standard regression model, it is usual to have lower absolute weights as compared to loadings **(**Rai, Patnayakuni and Seth 2006). As there is no established threshold/minimum value for indicator weights, the statistical significance of these weights indicates the relative importance of the formative indicators, created using the factor score from the linear composites of the first order items, in forming the second-order latent construct**.** Figure 7.3 shows that contractual arrangements and contract choice did not have significant formative weights for the vertical coordination and inter-firm relationship strength constructs respectively, whereas all other formative weights were significant.

Figure 7.3 The Weights of the Formative Second-Order Construct Model in PLS



***Significant at α = 0.000 **Significant at α = 0.005 *Significant at α = 0.05

As stated at the beginning of the assessment of measurement model section, loadings and internal consistency are not important for the reliability of formative items. The "primary statistics for assessing a formative indicator is its weight, the partialized effect of the indicator on its intended construct" (Cenfetelli and Bassellier 2009, p. 691), which can support the theoretical formation of the latent construct. Therefore, the weights of the second-order formative items are reported to show their influence and contribution in the model to meet the study objectives. Cenfetelli and Bassellier (2009) also suggested interpreting the formative measurement results by examining multicollinearity, the possible co-occurrence of negative and positive indicator weights and the absolute versus relative contributions made by a formative indicator.

Since formative measurement is analogous to multiple regressions (beta weights) being compared to the reflective measures as simple regression, it is more likely that some indicators will have low or non-significant weights depending on the number of indicators. Moreover, the co-occurrence of negative and positive weight indicators is common in single formative constructs because of the pattern of correlations among indicators where suppression occurs if an indicator shares more variance with another indicator than the formative construct (Cenfetelli and Bassellier 2009). Thus, a negative indicator weight does not mean an overall negative affect on the associated construct.

Table 7.8 shows the presence of both positive and negative indicator weights in the *relationship strength* construct. The first order indicator contract *choice* has a negative weight, which is not significant and has a near zero weight. The indicator contractual arrangement in the vertical coordination construct also has near zero weight.

Table 7.8 Weights and Loadings of the Higher Order Constructs

Second-Order Construct	1st-order construct used as second-order indicators	Weight	Loading	T-Statistics	Significance
Vertical Coordination	Coordination of Work	0.855		13.1601	p <0.000
	Contractual arrangement	0.038		0.222	Not significant
	Formalization of transaction	0.305		1.9424	p <0.05
SC Performance	Customer facing	0.456		4.5327	p <0.000
	Internal-facing	0.679		7.7972	p <0.000
Inter-firm Relationship Strength	Trust	0.305		4.4251	p <0.000
	Mutual Investment	0.402		6.203	p <0.000
	Interdependence	0.198		2.0597	p <0.05
	Contract choice	-0.037		0.604	Not significant
	Commitment	0.628		8.0732	p <0.000
Knowledge Asset Management	Acquisition and learning		0.790	33.445	p <0.000
	Accessibility		0.679	17.951	p <0.000
	Information Sharing		0.773	29.796	p <0.000
	Usage		0.876	69.196	p <0.000
	Memory		0.817	40.256	p <0.000

Cenfetelli and Bassellier (2009) have argued that a small weight indicator suggests a relatively small contribution to a formatively measured construct compared to its other indicators, but it still may have an important contribution when the loading of the indicator is high. They suggest checking the loadings/bivariate correlations of the indicator with its constructs. They also suggest checking its theoretical relevance to decide whether the item will be deleted or not. The bivariate correlations between indicators and constructs in both cases were found high (contract choice = .497**; contractual arrangement = .584**). Although the items of contract choice are taken from the literature where it has been found significant as a separate independent construct, (see Schulze, Spiller and Theuvsen 2006; Szabo and Barbos 2006), the items of contractual arrangement were developed from scratch using the literature and results of the field study. The current study used them as sub-constructs/first order indicators in a formative direction to measure the respective second-order construcst. Therefore, considering their application in a multidimensional construct in a new context, it was decided to keep the two formative indicators at this stage of analysis.

Studies suggest testing the multi-collinearity of the formative indicators to avoid unstable indicator weights and estimation biases (Petter, Straub and Rai 2007; Pavlou and Fygenson 2006, Cenfetelli and Bassellier 2009), although it is argued also that collinearity will not be a threat to the structural model and not affect the predictive effectiveness of the formative construct (Chin 1998b; Mackenzie *et al.* 2005). Multicollinearity is desirable for the reflective construct, but it is undesirable for a formative model because indicators are assumed to represent the diverse and distinctive aspects of a construct and are not highly correlated. Therefore, collinearity tests can indicate conceptual redundancy among the chosen dimension or indicators.

Multicollinearity can be tested using bivariate correlations among the indicators or using the variance inflation factor (VIF) and tolerance statistics, which are mainly centred on the correlation among the predictors using size of $1 - R^2_{(j)}$ (Cenfetelli and Bassellier 2009). The more stringent value for acceptable VIF is <3.3 (Diamantopoulos and Siguaw 2006) while a more flexible value is <10.00 (Hair *et al*. 1998), which indicates an absence of collinearity. Besides, if the tolerance is below 0.1 and Eigenvalues of the correlation matrix significantly depart from 1.00, they may indicate collinearity. The SPSS regression collinearity diagnostic was run by using the PLS latent variable construct score (second-order construct) as a dependent variable and the indicators/first-order construct scores (using PLS scores as well) as independent variables to obtain the VIF, tolerance and eigenvalues. The results for all three formative multidimensional construct are given in Tables 7.9a, 7.9b, and

7.9c. VIF values ranged from 1.042 to 2.231 which is <3.3. Eigenvalues and tolerance statistics also suggested that all tested formative dimensions/indicators do not overlap and are not designed to represent the same aspect.

Table 7.9a Collinearity Diagnostics for Inter-Firm Relationship Strength

Dimension	Collinearity Statistics		Eigen value	Variance Proportions					
	Tolerance	VIF		(Constant)	Mutual Investment	Interdependence	Trust	Contract Choice	Commitment
1			5.361	.00	.01	.01	.00	.00	.00
2	.959	1.042	.263	.00	.76	.30	.00	.00	.00
3	.943	1.061	.225	.01	.21	.66	.01	.06	.01
4	.882	1.133	.086	.01	.02	.02	.09	.78	.10
5	.978	1.023	.043	.05	.00	.01	.31	.00	.87
6	.842	1.188	.022	.93	.00	.00	.59	.14	.02

Table 7.9b Collinearity Diagnostics for Vertical coordination

Dimension	Collinearity Statistics		Eigen value	Variance Proportion			
	Tolerance	VIF		(Constant)	Coordination of work	Formalization of Transaction	Contractual Arrangement
1			3.640	.00	.00	.01	.01
2	.918	1.089	.248	.07	.07	.07	.21
3	.448	2.231	.074	.03	.00	.89	.76
4	.470	2.128	.038	.90	.93	.03	.02

Table 7.9c Collinearity Diagnostics for SC performance

	Collinearity Statistics		Eigen value	Variance Proportions		
Dimension	Tolerance	VIF		(Constant)	Customer Facing	Internal Facing
1			2.958	0	0	0
2	0.711	1.406	0.023	0.94	0.07	0.44
3	0.711	1.406	0.02	0.06	0.92	0.56

7.5.1.2 Internal consistency

The second reliability measure to evaluate the reflective measurement model in PLS is the internal consistency or constructs composite reliability (ρξ) that assesses the inter-item consistency following the procedure of Fornell and Larcker (1981). It is computed by the sum of the individual squared loadings divided by the sum of the individual squared loadings plus the sum of the error terms. Although the interpretation is similar to Cronbach's alpha, Fornell and Larcker (1981) argued that their measure to calculate internal consistency is superior because it uses item loadings estimated within the causal model and is not influenced by the number of items (Barclay, Higgins and Thompson 1995, Hanlon 2001). The equation of calculating internal consistency is given below:

$$\text{Internal consistency} = \frac{\left(\sum \lambda_{\gamma i}\right)^2}{\left(\sum \lambda_{\gamma i}\right)^2 + \sum Var\left(\varepsilon_i\right)}$$

Where Var (ε_i) = $1-\lambda_{\gamma i}^2$ and λ is the item loading and ε is the error

Normally, the benchmark point to achieve adequate internal consistency reliability is 0.70 (Barclay, Higgins and Thompson 1995; Nunnaly 1978). Table 7.10 below shows that all reflective latent constructs have more than adequate internal consistency composite reliability score, and thus are deemed reliable. Most of the constructs achieved an internal consistency of 0.8, where the minimum score was 0.75 for the construct competition intensity and the maximum score was 0.911 for IOS use construct.

Table 7.10 Assessment of the Internal Consistency and AVE

Construct	CR	AVE
Competition Intensity (CP)	0.779	0.542
Environmental Management (EV)	0.824	0.701
Vertical Coordination (VC)	N/A	N/A*
Coordination of Work (CD)	0.783	0.637
Formalization of Transaction (FT)	0.819	0.532
Contractual Arrangement (CA)	0.893	0.736
Transaction Climate (TC)	0.859	0.554

Price Uncertainty (PU)	0.795	0.564
Negotiation Power (NP)	0.845	0.731
Inter-firm Relationship Strength (RS)	N/A*	N/A*
Interdependence (IP)	0.911	0.859
Trust (TR)	0.813	0.612
Mutual Investment (MI)	0.89	0.731
Commitment (CM)	0.738	0.585
Contract Choice		0.762
Knowledge Asset Management (KAM)	0.891	0.623
Acquisition and Learning (AL)	0.881	0.649
Accessibility (AC)	0.912	0.838
Shared Meaning (SM)	0.746	0.595
Memory (MM)	0.889	0.8
Usage (US)	0.898	0.687
IOS Use (IOS)	0.92	0.589
SC Performance (PR)	N/A*	N/A*
Customer-Facing (CF)	0.887	0.723
Internal-Facing (IF)	0.763	0.522
Competitiveness (CMP)	0.876	0.639

*2nd order formative construct, therefore values are not applicable

A more conservative test of reliability and convergent validity can be made through average variance extracted (AVE) from the constructs by their items (Fornell and Larcker 1981, Hanlon 2001, Johnston *et al.* 2004). AVE measures the amount of variance captured by a construct and shows the sum of the measurement item variance as extracted by the construct in relation to the measurement error' (Hanlon, 2001). AVE should equal or exceed 0.5 for adequate convergent validity; meaning that the items, on average, share at least half of their variance with the construct (Fornell and Larcker 1981; Johnston *et al.* 2004). Table 7.10 showed that all constructs performed acceptably on this standard. The lowest AVE was 0.54. Thus the collective evidence suggests that all the constructs demonstrate good measurement properties.

Although the test of internal consistency is not a requirement for formative constructs, as stated earlier, the results indicated that all the second-order formative constructs have adequate internal consistency in the current empirical context. However, it is not uncommon foe researchers to report the test of reliability indices such as Cronbach's alpha, for the formative constructs, but the point is this test sometime can be misleading and inappropriate because two variables that might even be negatively related can both serve as meaningful indicators for formative constructs (Coltman *et al.* 2008; Petter, Straub and Rai 2007).

7.5.1.3 Discriminant validity

Discriminant validity indicates the extent to which a given construct and its measurement items are different from other constructs and their measurement items. It addresses the potential problem of having measures for one construct overlap the conceptual territory of another construct. For adequate discriminant validity, PLS requires that a construct should share more variance with its measures than it shares with other constructs in the model; i.e., the latent construct demonstrably should be closer to its measurement items than to any other construct (Barclay, Higgins and Thompson 1995; Johnston *et al.* 2004). Thus the following two rules should be satisfied for adequate discriminant validity (Agarwal and Karahanna, 2000; Chin, Marcolin and Newsted 2003; Quaddus and Hofmeyer 2007; Rai, Patnayakuni and Seth 2006)

i) Indicator Level Discriminant Validity: Manifest variables should load more strongly on their respective theoretically assigned construct than on any other constructs in the model; i.e., an individual construct's item loading should be higher than cross-loading.

ii) Construct Level Discriminant Validity: The square root of AVE of an individual construct should be much larger than inter-construct correlations.

To meet the first rule, discriminant validity was assessed by factor analyzing items used to create all the reflective constructs, as well as the reflective sub-constructs that were grouped under second-order constructs. The latent variable scores were calculated in PLS bootstrapping based on the weighted sum of the indicators. Then, using SPSS, these scores were correlated with all other indicators to calculate cross loadings. The CFA (Confirmatory Factor Analysis) results in Table 7.11 show that all the indicators more loaded highly on their respective construct than other constructs, giving sufficient empirical evidence that each measure was tapping into distinct and different concepts. For this reason, there was no need to delete any further items from the research model.

Table 7.11 Loading and Cross Loading Matrix

Items	Factors																					
	CP	**EV**	**IOS**	**CMP**	**CD**	**FT**	**CA**	**AL**	**AC**	**SM**	**US**	**MM**	**CF**	**IF**	**MI**	**IP**	**TR**	**CM**	**CN**	**TC**	**PU**	**NP**
CP1	**0.76**	0.00	0.17	0.27	0.28	0.19	0.13	0.17	0.21	0.20	0.18	0.24	0.24	0.28	0.20	0.14	0.22	0.26	0.02	0.26	-0.10	0.32
CP2	**0.81**	0.24	0.17	0.22	0.26	0.22	0.17	0.15	0.21	0.13	0.17	0.20	0.20	0.25	0.21	0.09	0.26	0.23	0.05	0.26	-0.18	0.33
CP3	**0.64**	0.36	0.24	0.19	0.20	0.17	0.20	0.22	0.19	0.22	0.17	0.17	0.15	0.12	0.16	-0.01	0.21	0.17	0.19	0.16	0.01	0.11
EV1	0.22	**0.89**	0.13	0.15	0.16	0.08	0.04	0.14	0.15	0.11	0.18	0.15	0.17	0.13	0.02	-0.07	0.13	-0.01	0.04	0.12	-0.04	0.14
EV2	0.23	**0.77**	0.10	0.14	0.22	0.03	-0.02	0.06	0.10	0.10	0.10	0.07	0.14	0.11	-0.08	-0.10	0.17	0.12	0.03	0.11	0.05	0.08
IS1	0.24	0.12	**0.85**	0.28	0.25	0.18	0.14	0.32	0.27	0.29	0.39	0.39	0.21	0.19	0.21	0.19	0.19	0.26	0.13	0.27	-0.05	0.27
IS2	0.24	0.15	**0.78**	0.26	0.23	0.12	0.08	0.33	0.31	0.35	0.36	0.39	0.22	0.20	0.12	0.15	0.24	0.30	0.13	0.27	-0.07	0.26
IS4	0.21	0.07	**0.73**	0.28	0.24	0.15	0.13	0.31	0.25	0.30	0.31	0.34	0.13	0.19	0.15	0.15	0.17	0.25	0.09	0.23	-0.10	0.29
IS5A	0.22	0.11	**0.66**	0.20	0.28	0.23	0.17	0.35	0.24	0.31	0.37	0.38	0.19	0.14	0.16	0.16	0.15	0.23	0.12	0.22	-0.06	0.25
IS5B	0.14	0.07	**0.79**	0.27	0.18	0.22	0.19	0.31	0.21	0.31	0.31	0.30	0.13	0.17	0.17	0.19	0.10	0.27	0.18	0.26	-0.15	0.26
IS5C	0.12	0.06	**0.78**	0.27	0.16	0.23	0.20	0.33	0.18	0.28	0.33	0.29	0.10	0.15	0.17	0.20	0.09	0.25	0.19	0.29	-0.15	0.27
IS5D	0.18	0.11	**0.74**	0.26	0.20	0.21	0.18	0.35	0.25	0.28	0.40	0.34	0.12	0.16	0.16	0.15	0.03	0.24	0.23	0.27	-0.07	0.19
IS5E	0.22	0.17	**0.77**	0.25	0.21	0.13	0.10	0.32	0.26	0.26	0.38	0.35	0.19	0.16	0.17	0.12	0.19	0.20	0.13	0.23	-0.07	0.28
CMP1	0.17	0.11	0.25	**0.78**	0.32	0.14	0.09	0.33	0.26	0.25	0.35	0.31	0.33	0.51	0.25	0.17	0.20	0.23	-0.08	0.31	-0.26	0.32
CMP2	0.25	0.13	0.23	**0.81**	0.35	0.11	0.09	0.31	0.23	0.24	0.36	0.38	0.40	0.49	0.26	0.16	0.19	0.29	-0.05	0.34	-0.25	0.30
CMP3	0.30	0.18	0.35	**0.79**	0.35	0.23	0.13	0.40	0.27	0.36	0.37	0.39	0.36	0.46	0.28	0.22	0.16	0.38	0.02	0.33	-0.31	0.38
CMP4	0.27	0.12	0.25	**0.82**	0.38	0.14	0.10	0.41	0.35	0.29	0.43	0.46	0.42	0.49	0.23	0.19	0.17	0.33	0.00	0.34	-0.29	0.38
CD1	0.41	0.26	0.29	0.37	**0.83**	0.26	0.22	0.24	0.31	0.24	0.25	0.31	0.32	0.31	0.18	0.11	0.27	0.23	-0.03	0.32	-0.28	0.35
CD3	0.12	0.07	0.14	0.34	**0.76**	0.19	0.12	0.28	0.16	0.30	0.37	0.24	0.16	0.24	0.21	0.10	0.19	0.22	-0.02	0.29	-0.17	0.32
FT2	0.20	0.08	0.15	0.06	0.21	**0.73**	0.53	0.14	0.02	0.16	0.13	0.06	0.13	0.10	0.13	0.07	0.11	0.08	0.21	0.09	0.04	0.10
FT2a	0.20	0.02	0.21	0.22	0.23	**0.80**	0.59	0.15	0.11	0.15	0.08	0.12	0.17	0.20	0.25	0.18	0.15	0.15	0.20	0.21	-0.19	0.23
FT3	0.14	0.07	0.18	-0.01	0.18	**0.57**	0.45	0.09	0.00	0.09	0.06	0.06	0.06	0.06	0.16	0.10	0.07	0.03	0.20	0.09	-0.02	0.08
FT3a	0.22	0.05	0.26	0.22	0.25	**0.66**	0.57	0.20	0.13	0.16	0.10	0.18	0.20	0.25	0.26	0.21	0.13	0.20	0.22	0.27	-0.23	0.28

Table 7.11 Continued …

Items	Factors																				
	CP	**EV**	**IOS**	**CMP**	**CD**	**FT**	**CA**	**AL**	**AC**	**SM**	**US**	**MM**	**CF**	**IF**	**MI**	**IP**	**TR**	**CM**	**CN**	**TC**	**PU**	**NP**
CA1	0.14	0.01	0.18	0.05	0.14	0.59	**0.85**	0.10	-0.03	0.07	0.00	0.02	0.06	0.12	0.18	0.12	0.13	0.05	0.30	0.13	0.00	0.13
CA2	0.27	0.04	0.18	0.17	0.27	0.73	**0.91**	0.22	0.09	0.16	0.10	0.12	0.16	0.19	0.22	0.09	0.10	0.11	0.28	0.15	-0.09	0.19
CA3	0.14	-0.02	0.13	0.08	0.10	0.52	**0.80**	0.08	0.04	0.04	0.01	0.02	0.00	0.14	0.25	0.15	0.11	0.11	0.27	0.20	-0.04	0.17
AL1	0.13	0.08	0.35	0.23	0.22	0.17	0.23	**0.70**	0.31	0.33	0.44	0.39	0.13	0.18	0.23	0.08	0.11	0.22	0.24	0.22	-0.09	0.17
AL2	0.18	0.16	0.30	0.36	0.27	0.11	0.09	**0.82**	0.30	0.42	0.50	0.44	0.24	0.23	0.16	0.09	0.07	0.25	0.08	0.23	-0.13	0.17
AL3	0.19	0.06	0.29	0.41	0.28	0.16	0.10	**0.84**	0.29	0.47	0.52	0.42	0.23	0.29	0.21	0.12	0.07	0.21	0.03	0.24	-0.13	0.23
AL4	0.28	0.11	0.43	0.43	0.28	0.18	0.13	**0.86**	0.30	0.53	0.59	0.54	0.29	0.27	0.23	0.16	0.13	0.28	0.09	0.27	-0.06	0.26
AC1	0.28	0.10	0.28	0.32	0.27	0.10	0.08	0.37	**0.92**	0.28	0.49	0.44	0.32	0.28	0.21	0.08	0.28	0.31	0.14	0.37	-0.26	0.31
AC2	0.23	0.18	0.31	0.32	0.28	0.06	0.00	0.31	**0.91**	0.28	0.47	0.46	0.22	0.21	0.16	0.06	0.27	0.23	0.01	0.34	-0.22	0.24
SM1	0.12	0.01	0.15	0.14	0.17	0.10	0.05	0.19	0.21	**0.55**	0.19	0.17	0.01	0.05	0.04	-0.04	0.15	0.17	0.07	0.19	-0.14	0.08
SM2	0.24	0.15	0.38	0.36	0.32	0.19	0.12	0.56	0.26	**0.93**	0.51	0.44	0.28	0.24	0.21	0.15	0.12	0.23	0.10	0.21	-0.09	0.26
US1	0.19	0.21	0.39	0.39	0.35	0.12	0.07	0.62	0.39	0.54	**0.84**	0.49	0.26	0.24	0.23	0.12	0.14	0.24	0.09	0.32	-0.14	0.20
US2	0.12	0.22	0.32	0.38	0.27	0.07	-0.02	0.55	0.38	0.47	**0.86**	0.49	0.25	0.23	0.22	0.10	0.14	0.22	0.11	0.29	-0.16	0.17
US3	0.21	0.06	0.33	0.35	0.32	0.11	0.04	0.41	0.46	0.30	**0.77**	0.56	0.31	0.25	0.14	0.15	0.20	0.37	0.13	0.34	-0.14	0.32
US4	0.25	0.08	0.46	0.44	0.34	0.16	0.09	0.53	0.51	0.36	**0.85**	0.67	0.31	0.28	0.24	0.15	0.25	0.44	0.16	0.41	-0.20	0.35
MM1	0.20	0.13	0.46	0.45	0.27	0.09	0.09	0.55	0.40	0.41	0.61	**0.90**	0.27	0.30	0.21	0.21	0.19	0.32	0.10	0.37	-0.13	0.30
MM2	0.30	0.11	0.35	0.42	0.35	0.13	0.04	0.45	0.48	0.38	0.58	**0.90**	0.42	0.31	0.24	0.26	0.22	0.40	0.03	0.43	-0.28	0.41
CF1	0.26	0.15	0.17	0.43	0.24	0.18	0.09	0.24	0.24	0.21	0.28	0.33	**0.86**	0.51	0.16	0.13	0.13	0.26	0.03	0.19	-0.19	0.28
CF2	0.16	0.12	0.16	0.32	0.22	0.16	0.07	0.19	0.26	0.16	0.24	0.31	**0.86**	0.44	0.14	0.07	0.21	0.27	0.01	0.22	-0.17	0.20
CF3	0.26	0.18	0.18	0.45	0.32	0.16	0.10	0.28	0.25	0.23	0.34	0.33	**0.83**	0.59	0.18	0.16	0.19	0.36	0.03	0.24	-0.26	0.33
IF1	0.28	0.17	0.21	0.53	0.34	0.21	0.21	0.35	0.28	0.28	0.35	0.36	0.61	**0.75**	0.21	0.15	0.15	0.37	0.04	0.39	-0.28	0.34
IF3	0.10	0.12	0.08	0.28	0.15	0.06	0.04	0.06	0.09	0.03	0.05	0.04	0.26	**0.60**	0.11	0.08	0.17	0.05	0.04	0.11	-0.13	0.21
IF4	0.22	0.02	0.15	0.45	0.22	0.14	0.10	0.17	0.17	0.10	0.17	0.25	0.36	**0.78**	0.24	0.14	0.20	0.19	-0.04	0.27	-0.35	0.36
MI1	0.28	0.03	0.21	0.34	0.23	0.21	0.19	0.21	0.21	0.21	0.21	0.24	0.22	0.27	**0.84**	0.11	0.17	0.16	-0.04	0.26	-0.18	0.36
MI2	0.18	-0.03	0.18	0.24	0.20	0.23	0.26	0.24	0.17	0.16	0.25	0.20	0.14	0.21	**0.87**	0.07	0.12	0.09	0.13	0.21	-0.13	0.23
MI3	0.20	-0.06	0.14	0.22	0.18	0.22	0.20	0.21	0.14	0.14	0.19	0.19	0.11	0.21	**0.85**	0.13	0.09	0.13	0.05	0.18	-0.12	0.29

Table 7.11 Continued …

Items	Factors																					
	CP	EV	IOS	CMP	CD	FT	CA	AL	AC	SM	US	MM	CF	IF	MI	IP	TR	CM	CN	TC	PU	NP
IP2	0.10	-0.11	0.22	0.23	0.12	0.18	0.14	0.15	0.09	0.14	0.16	0.24	0.12	0.18	0.15	**0.93**	0.14	0.17	0.09	0.15	-0.14	0.30
IP2A	0.09	-0.06	0.18	0.20	0.12	0.12	0.11	0.11	0.05	0.07	0.12	0.24	0.15	0.15	0.07	**0.92**	0.10	0.24	0.04	0.20	-0.07	0.26
TR1	0.18	0.20	0.17	0.11	0.24	0.05	0.06	0.11	0.21	0.10	0.21	0.23	0.09	0.15	0.09	0.10	**0.64**	0.22	0.07	0.23	-0.12	0.19
TR1A	0.19	0.20	0.12	0.10	0.16	0.07	0.08	0.12	0.19	0.10	0.15	0.17	0.15	0.24	0.08	0.04	**0.62**	0.19	0.13	0.21	-0.09	0.16
TR2	0.23	0.09	0.14	0.18	0.27	0.17	0.11	0.05	0.23	0.13	0.17	0.14	0.19	0.16	0.13	0.14	**0.82**	0.27	0.00	0.44	-0.21	0.32
TR2A	0.30	0.07	0.14	0.23	0.18	0.18	0.11	0.09	0.24	0.14	0.14	0.16	0.16	0.17	0.14	0.09	**0.80**	0.26	-0.05	0.41	-0.28	0.29
CM1	0.30	0.10	0.31	0.37	0.26	0.14	0.12	0.31	0.28	0.26	0.38	0.41	0.33	0.29	0.14	0.19	0.28	**0.93**	0.10	0.55	-0.21	0.37
CM2	0.25	-0.01	0.29	0.35	0.25	0.15	0.08	0.25	0.27	0.22	0.34	0.33	0.32	0.29	0.14	0.21	0.33	**0.93**	0.17	0.53	-0.24	0.31
CN1	0.04	-0.03	0.13	-0.04	-0.02	0.15	0.22	0.15	0.10	0.07	0.15	0.10	0.04	0.02	-0.02	0.11	-0.03	0.10	**0.76**	0.07	0.11	0.03
CN2	0.04	0.02	0.09	-0.03	-0.06	0.19	0.20	0.07	0.05	0.09	0.12	0.02	0.02	-0.02	0.01	0.03	0.03	0.11	**0.77**	0.08	0.05	-0.01
CN3	0.16	0.10	0.21	-0.01	0.01	0.24	0.30	0.09	0.04	0.10	0.07	0.04	0.01	0.04	0.10	0.03	0.06	0.12	**0.73**	0.09	0.05	0.04
TC1	0.27	0.15	0.29	0.33	0.36	0.15	0.14	0.26	0.36	0.26	0.36	0.38	0.27	0.29	0.19	0.11	0.40	0.46	0.10	**0.82**	-0.22	0.37
TC1A	0.24	0.17	0.21	0.34	0.29	0.11	0.10	0.18	0.35	0.21	0.30	0.35	0.23	0.32	0.17	0.03	0.45	0.47	0.09	**0.84**	-0.25	0.31
TC2	0.26	0.08	0.33	0.33	0.33	0.20	0.14	0.25	0.36	0.23	0.38	0.43	0.22	0.33	0.29	0.17	0.40	0.57	0.02	**0.80**	-0.31	0.36
TC3	0.20	0.06	0.23	0.26	0.21	0.15	0.19	0.23	0.15	0.08	0.23	0.22	0.08	0.24	0.14	0.22	0.18	0.29	0.12	**0.62**	-0.17	0.27
TC3A	0.17	0.03	0.14	0.25	0.20	0.15	0.14	0.18	0.14	0.10	0.21	0.20	0.10	0.25	0.12	0.21	0.20	0.31	0.14	**0.61**	-0.19	0.24
PU4	-0.02	0.01	-0.08	-0.22	-0.19	-0.08	-0.05	-0.01	-0.14	0.00	-0.06	-0.11	-0.17	-0.19	-0.19	-0.15	-0.17	-0.11	0.03	-0.16	**0.65**	-0.32
PU5	0.03	0.05	0.06	-0.16	-0.11	-0.02	0.05	0.03	-0.08	0.01	0.01	-0.03	-0.16	-0.21	0.02	0.06	-0.18	-0.07	0.20	-0.10	**0.66**	-0.13
PU6	-0.11	0.00	-0.09	-0.22	-0.26	-0.12	-0.02	-0.08	-0.20	-0.17	-0.13	-0.15	-0.19	-0.24	-0.02	-0.04	-0.14	-0.13	0.05	-0.20	**0.64**	-0.20
NP1	0.30	0.12	0.28	0.42	0.39	0.20	0.16	0.23	0.27	0.23	0.28	0.34	0.29	0.39	0.29	0.31	0.34	0.35	0.00	0.38	-0.38	**0.89**
NP3	0.30	0.11	0.30	0.32	0.32	0.17	0.18	0.21	0.25	0.20	0.25	0.34	0.25	0.35	0.31	0.19	0.23	0.26	0.05	0.34	-0.21	**0.82**

[CP=Competition Intensity, EV=Environmental Management, IOS= Inter-organizational system, CMP=Competitiveness, CD=Coordination of Work, FT=Formalization of Transaction, CA=Contractual Arrangement, AL=Acquisition and Learning, AC=Accessibility, SM=Shared Meaning, US=Knowledge Usage, MM=Memory, CF=Customer Facing, IF= Internal Facing, MI=Mutual Investment, IP=Interdependence, TR=Trust, CM=Commitment, CN=Contract choice, TC= Transaction Climate, PU=Price Uncertainty, NP=Negotiation Power]

To meet the second rule, PLS requires an appropriate AVE (Average Variance Extracted) analysis. In PLS, AVE is estimated using the following equation and can be used to assess the variance shared between the construct and its measurement items (Fornell and Larcker 1981).

$$\text{Average Variance Extracted (AVE)} = \frac{\sum \lambda_{\gamma i}^{2}}{\sum \lambda_{\gamma i}^{2} + \sum Var\ (\varepsilon_i)}$$

Where Var (ε_i) = 1-$\lambda_{\gamma i}^2$ and λ is the item loading and ε is the error

A construct is considered to be distinct from other constructs if the square root of its AVE is greater than its correlations with other latent constructs (Barclay, Higgins, and Thompson 1995; Rai, Patnayakuni and Seth 2006). Again, output of PLS bootstrapping is used for estimating AVE and the latent variable correlation matrix, then the diagonal of the correlation matrix was replaced by the squared AVE to judge the discriminant validity of each of the construct. Table 7.12 shows the results. As a rule of thumb, for adequate discriminant validity, square root of AVE should be significantly greater than the off-diagonal elements in the corresponding rows and columns. Table 7.12 shows all the constructs demonstrate acceptable performance on this basis because in all cases, the square rooted AVE (diagonal element) for every construct was greater than the inter-correlations of the construct with the other constructs in the model.

Thus, it can be concluded that the discriminant validity checks at both the indicator and construct levels provide sufficient empirical evidence that all the constructs and the sub-constructs theoretically assumed to be distinct and multi-dimensional, in fact, were observed as distinct and multi-dimensional.

Table 7.12 Correlation of Latent Variables and the Square Root of AVE

	CP	EV	IOS	CMP	TC	PU	NP	IP	TR	MI	AL	AC	MM	SM	US	CM	CD	FT	CA	CF	IF	CN
CP	**0.74**																					
EV	0.26	**0.84**																				
IOS	0.26	0.14	**0.77**																			
CMP	0.31	0.17	0.34	**0.80**																		
TC	0.31	0.14	0.34	0.41	**0.74**																	
PU	-0.05	0.02	-0.06	-0.28	-0.21	**0.75**																
NP	0.35	0.14	0.34	0.44	0.42	-0.30	**0.85**															
IP	0.10	-0.09	0.21	0.23	0.19	-0.07	0.30	**0.93**														
TR	0.31	0.19	0.19	0.22	0.45	-0.20	0.33	0.13	**0.78**													
MI	0.25	-0.03	0.21	0.31	0.25	-0.09	0.34	0.12	0.15	**0.85**												
AL	0.25	0.13	0.43	0.45	0.30	-0.03	0.26	0.14	0.12	0.26	**0.81**											
AC	0.28	0.15	0.32	0.35	0.39	-0.19	0.30	0.08	0.30	0.20	0.37	**0.92**										
MM	0.28	0.14	0.45	0.48	0.45	-0.13	0.40	0.26	0.24	0.24	0.56	0.49	**0.89**									
SM	0.23	0.10	0.35	0.32	0.26	-0.10	0.22	0.07	0.17	0.16	0.49	0.31	0.39	**0.77**								
US	0.23	0.17	0.46	0.47	0.41	-0.09	0.31	0.15	0.23	0.25	0.64	0.52	0.66	0.45	**0.83**							
CM	0.14	0.04	0.21	0.26	0.36	-0.07	0.23	0.14	0.21	0.09	0.19	0.14	0.28	0.22	0.24	**0.76**						
CD	0.33	0.21	0.28	0.44	0.38	-0.25	0.42	0.13	0.29	0.24	0.33	0.30	0.35	0.32	0.39	0.11	**0.80**					
FT	0.26	0.08	0.28	0.18	0.23	-0.13	0.24	0.20	0.15	0.28	0.20	0.09	0.15	0.19	0.12	0.09	0.29	**0.73**				
CA	0.22	0.01	0.19	0.12	0.18	-0.01	0.19	0.14	0.13	0.25	0.15	0.04	0.06	0.10	0.04	0.04	0.20	0.72	**0.86**			
CF	0.26	0.18	0.21	0.47	0.26	-0.23	0.31	0.14	0.20	0.18	0.28	0.29	0.38	0.18	0.33	0.22	0.30	0.20	0.09	**0.85**		
IF	0.27	0.13	0.20	0.57	0.34	-0.28	0.42	0.17	0.25	0.25	0.25	0.23	0.29	0.15	0.25	0.13	0.31	0.20	0.15	0.54	**0.72**	
CN	0.10	0.03	0.18	-0.04	0.11	0.11	0.02	0.07	0.03	0.04	0.13	0.08	0.07	0.10	0.16	0.09	-0.04	0.27	0.31	0.03	0.00	**0.87**

7.5.2 Assessment of the Structural Model (Inner Model)

After conducting and meeting all the criteria for assessing the measurement model through the confirmatory factor analysis procedure of PLS in the previous stages, it was time to assess the statistical significance of the loadings and of the path coefficients (standardized βs) between constructs in the structural model (Barclay, Higgins and Thompson 1995). As specified in Chapter 5, the structural model consists of hypothesized relationships between latent constructs. The significance of the relationships is tested by using the bootstrap (Efron and Tibshirani 1993) procedure in PLS (as discussed in Section 7.5). Bootstrapping is a re-sampling technique based on a defined number of sub-samples, such as 100, which are randomly chosen from the original sample to estimate the coefficient of each hypothesized path and corresponding t-values (similar to a t-test). The values are used for statistical significance/conclusion validity by testing the null hypotheses.

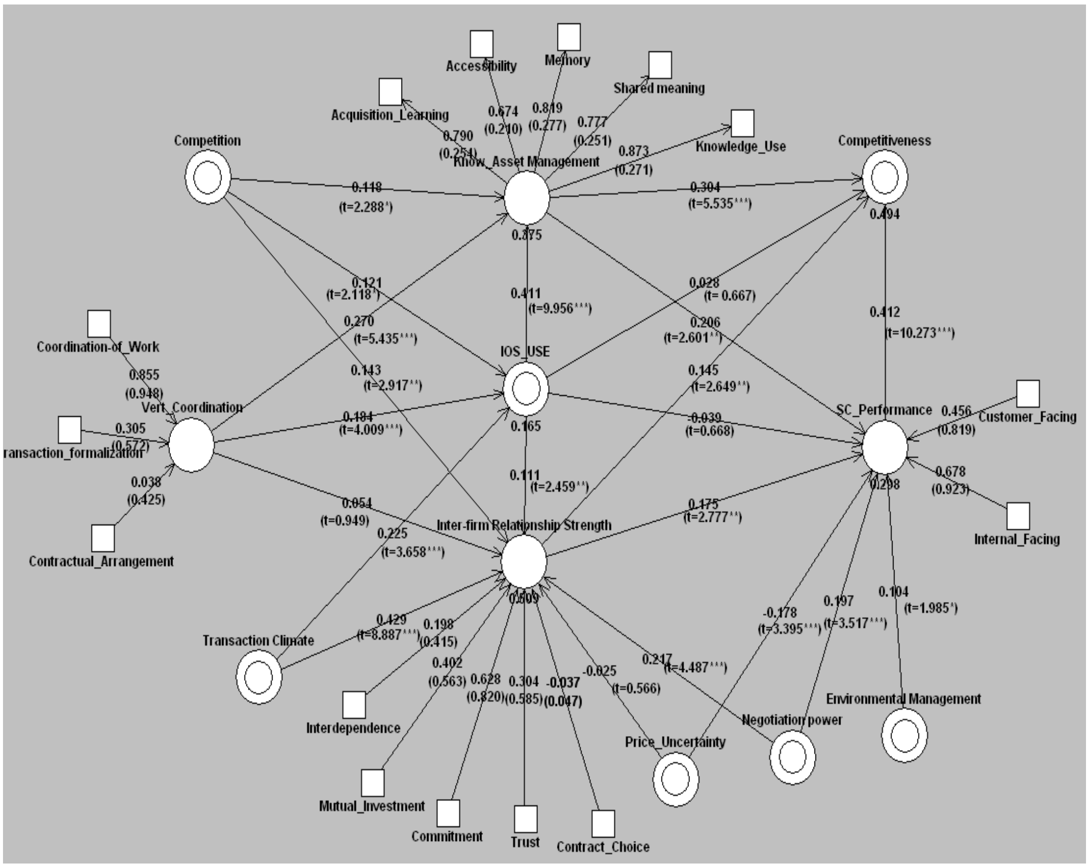
Bootstrapping also provides R^2 values for the endogenous constructs to asses the level of variance (AVE) explained by each construct and, thus, to explain the predictive power of the model.

The current study used an equal number of sub-samples (bootstrapping sample = 315 original sample = 315) for bootstrapping estimation to capture all the options presented by the original sample (Chin 1998b; Andreev 2009). It is important to note that PLS optimally weights the indicators of a latent variable to estimate the variable score. The weight is based on the exact linear combination of the indicators for maximizing the explained variance for the indicators and latent variables. The resulting latent variable score is not only correlated with its own set of indicators but also correlated with other latent variables of the structural model (Chin, Malcolin and Newsted 1996).

The graphical result extracted from PLS bootstrap analysis is presented in the Figure 7.4. It shows the direction and coefficient of each hypothesized path (beta weight) and corresponding t-values. R^2 values also are provided under each of the endogenous constructs (in circles). The boxes represent the linear composites of the first-order constructs. The standardized path estimates, which can be interpreted in the same manner as the path coefficients in multiple regressions, indicate the magnitude of the impact of an independent construct on a dependent construct.

The Table reveals that all paths (relationships), except four, are statistically significant and, thereby, support most of the hypotheses in the study. In terms of the path loading/path coefficient (beta weight), the result shows that KAM is the strongest predictor (β 0.206; t = 2.601; p <0.005) of SC performance, followed by negotiation power (β 0.197; t = 3.517; p< 0.000), price uncertainty (β -0.178; t=3.395; p<0.000), inter-firm relationship strength (β 0.175; t = 2.777 p<0.005) and environmental management (β 0.104; t = 1.985; p<0.05). The result also shows that SC performance (β 0.412; t = 10.273 p<0.000) is the strongest predictor of the competitiveness' of the industry, followed by KAM (β 0.304; t = 5.535; p<0.00) and inter-firm relationship strength (β 0.145; t = 2.649; p<0.005).

Figure 7.4 PLS Bootstrap Analyses for the Hypothesized Relationship



***Significant at α = 0.000 **Significant at α = 0.005 *Significant at α = 0.05

Among the antecedents of KAM, IOS use and relationship strength, Figure 7.4 shows all path coefficients, except one, are statistically significant. All the paths leading from the constructs *competition intensity* and *transaction climate* are significant. Of the three paths leading from vertical coordination to KAM, IOS use and inter-firm relationship strength, only the path leading to inter-firm relationship strength is found not to be significant.

It should be mentioned that the PLS path analysis, compared to the traditional regression analysis, calculates all the indirect effects of antecedent constructs in addition to the direct effect and shows the output as the total effect of a construct (Barclay, Higgins and Thompson 1995). Thus, the PLS result establishes the relative importance of the antecedent constructs by showing the total effect (direct + indirect) such as the case of KAM, IOS use and relationship strength, all of which have antecedent constructs in the model. Figure 7.4 shows KAM, and inter-firm relationship strength, have significant impacts on the SC performance and firm competitiveness, which are based on the total effect (direct + indirect). The result also establishes that given all the indirect effect of the antecedent constructs, SC performance very strongly and significantly influences the competitiveness of the industry. If there is no indirect effect involved (in the absence of antecedent construct) the total effect is equal to the respective path coefficient (i.e., the direct effect). For example, the path coefficients of price uncertainty, negotiation power and environmental management constructs and their relationships with SC performance, all were significant.

The results are also presented in Table 7.13 in terms of the hypothesized relationships where four relationships are not statistically significant, while the other eighteen have a high level of significance.

The table shows that the factors vertical coordination and price uncertainty do not influence the strength of inter-firm relationships significantly, although some level of positive or negative influence still exists. Interestingly, the effects of IOS use in SC performance and firm competitiveness are also found to be not significant. Although non-significant paths may be considered for deletion to achieve a more parsimonious model (Barclay, Higgins and Thompson 1995), the study retained the path in the structural model because the bulk of literature suggests not to delete the non-significant paths in an exploratory study when paths are theoretically justified and the sample size small (Hanlon 2001, Jackson, 2008; Gefen, Straub and Boudreau, 2000). However, the two other paths emanating from IOS that hypothesize a positive influence on KAM and inter-firm relationship strength have a high level of significance.

Table 7.13 Bootstrap Path Co-Efficient and Their T-Values for the Hypothesized Relationships in the Structural Model

Hypothesis	Path	Path Coefficient (β)	t-value	P –value (α)
H1a	Competition → KAM	0.118	2.288	0.022
H1b	Competition →IOS	0.121	2.118	0.034
H1c	Competition → Relationship Strength	0.143	2.917	0.003
H2	Environmental management → SC	0.104	1.985	0.048

	Performance			
H3a	Vertical Coordination. → KAM	0.270	5.435	0.000
H3b	Vertical Coordination. → IOS use	0.184	4.009	0.000
H3c	Vertical Coordination → Relationship strength	0.054	0.949	Not Significant
H4a	Trans. Climate → Relationship strength	0.429	8.887	0.000
H4b	Trans. Climate. → IOS Use	0.225	3.658	0.000
H5a	KAM → Competitiveness	0.304	5.535	0.000
H5b	KAM → SC Performance	0.206	2.601	0.009
H6a	IOS Use → Competitiveness	0.028	0.667	Not significant
H6b	IOS Use → SC Performance	-0.039	0.668	Not Significant
H6c	IOS Use → KAM	0.411	9.956	0.000
H6d	IOS Use →> Relationship Strength	0.111	2.459	0.014
H7a	Relationship Strength → Competitiveness	0.145	2.649	0.008
H7b	Relationship Strength → SC Performance	0.175	2.777	0.005
H8a	Price Uncertainty → Relationship Strength	-0.025	0.566	Not significant
H8b	Price Uncertainty → SC Performance	-0.178	3.395	0.000
H9a	Negotiation Power → Relationship Strength	0.217	4.487	0.000
H9b	Negotiation Power → SC Performance	0.197	3.517	0.000
H10	SC Performance → Competitiveness	0.0.412	10.273	0.000

7.5.2.1 Explanatory power of the model

The explanatory power or the nomological validity of the research model can be assessed by observing the R^2 of the endogenous constructs of the structural model (Barclay, Higgins and Thompson 1995, Santosa, Wei and Chan 2005). R^2 value of a latent construct should be at least 0.10 for an acceptable standard and can be used as a measure of the predictive power of a model and its endogenous constructs (Falk and Miller 1992). R^2 indicates the amount of variance in a construct explained by the model and can be interpreted in the same manner as R^2 obtained from a multiple regression analysis (Barclay, Higgins and Thompson 1995).

Table 7.14 R^2 Values for the Endogenous Construct

Construct	R^2
Knowledge Asset management (KAM)	**0.375**
IOS Use	**0.165**
Relationship strength	**0.509**
SC Performance	**0.298**
Competitiveness	**0.494**

The structural model testing in Table 7.4 shows that all endogenous constructs satisfy the rule of 0.10 for the R^2 value. The strongest R^2 value is 0.509 in relationship strength followed by 0.494 in industry competitiveness, 0.375 in KAM and 0.298 in SC performance. Thus, almost 50 percent of the variance for relationship strength and competitiveness, 37 percent variance for KAM, and 29 percent variance for SC performance were explained by the proposed model which is the indication of a relatively parsimonious model. The R^2 values presented in Table 7.14 show that that the lowest R^2 is 0.165 in IOS use. Overall, the variability explained by all the endogenous constructs gives the model a substantial nomological validity given the context where a large number of factors impact on these dependent constructs The model has adequate merit in that it explains over 25 percent of the variance in KAM, relationship strength, SC performance and Competitiveness.

7.5.2.2 Goodness-of-Fit (GOF)

The existing goodness of fit measures in covariance based SEM (e.g., LISREL, AMOS), such as a likelihood ratio chi square, are related to the ability of a model to account for the sample covariances and, therefore, assume that all measures are reflective (Chin 1998b). But by comparison, this study used variance based PLS-SEM for different objectives such as allowing formative measures, and allowing testing hypotheses by predicting some antecedent conditions for a dependent variable. Therefore, existing tools of PLS are not able to provide such measures of fit and lack an index that can provide a global validation of the model. Rather, PLS can explain the variance in a regression sense and provides measures like factor loading, R^2 and significance of relationships among constructs that can be more indicative of how well a model is performing. It has been argued that a good covariance fit does not support any conclusion compared to R^2 and factor loading, as the covariance fit only relates to how well parameter estimates are able to match the sample covariance, not how the latent variables or item measures are predicted (Fornell and Bookstein1982; Chin 1998b).

Recently, a global fit measure for PLS path modelling was suggested as the geometric mean of the average communality and the average R^2 for endogenous constructs (Tenenhaus *et al.* 2005):

$$\text{GoF} = \sqrt{\overline{communality} * \overline{R^2}}$$

The GOF can be an operational solution and may provide an index for validating the PLS model globally (Tenenhaus *et al.* 2005). Because communality equals AVE in the PLS path modeling, Wetzels *et al.* (2009) redefined the equation for GoF in the following way

$$\text{GoF} = \sqrt{\overline{AVE} * \overline{R^2}}$$

In line with the effect size criteria proposed by Cohen (1988) for R^2 such as small = 0.02; medium = 0.13; and large = 0.26, Wetzel *et al* (2009) defined the GOF criteria for effect sizes of R^2 by substituting the minimum average AVE of 0.50 (because the cut-off value for communality is 0.5)[4] and the effect sizes for R^2. Thus, the proposed criteria are GoF_{small} = 0.1, GoF_{medium} = 0.25, and GoF_{large} = 0.36 to serve as a baseline for validating the PLS model globally. Following the equation, a GoF value 0.5045 {GoF = square root (0.6914 * 0.3682) = 0.5045} is obtained for the proposed model in this study. Table 7.15 shows the complete model for the geometric mean of average AVE and average R^2. As the GoF value exceeds the cut-off value of 0.36 for the large effect size of R^2, it is concluded that the proposed model performs very well compared to the baseline values.

Table 7.15 Complete Model for Assessing the GoF Value

Construct	R^2	AVE
IOS Use	0.165	0.589
Competitiveness	0.494	0.639
Competition Intensity		0.542
Environment Management		0.701
Transaction Climate		0.554
Price Uncertainty		0.564
Negotiation Power		0.731
Inter-firm Relationship Strength	0.509	**N/A***
Interdependence		0.859
Trust		0.612
Mutual investment		0.731
Commitment		0.585
Contract choice		0.762
Knowledge Asset Management (KAM)	0.375	0.623
Acquisition and learning		0.649

[4] Suggested by Fornell and Larcker (1981)

Accessibility		0.838
Shared Meaning		0.595
Memory		0.800
Usage		0.687
Vertical coordination		N/A*
Coordination of work		0.637
Formalization of Transaction		0.532
Contractual Arrangement		0.736
SC Performance	0.298	**N/A***
Customer-Facing		0.723
Internal-Facing		0.522
Mean	**0.3682**	**0.691**

* Formative second order constructs therefore AVE is not applicable

7.6 Hypothesis Testing

After assessing the research model in terms of the measurement and structural parts using PLS based structural equation modelling technique, it is possible to make conclusions about hypotheses developed for the study. The hypotheses were assessed by examining path coefficients and the associated t-values computed from the PLS bootstrapping, and then explained based on R^2, the variance generated by the measurement (outer) and structural (inner) model. The model had a relatively good fit to the data as it explained about 29% of the total variability of 'SC performance' (R^2 = 0.298) and 49% of the total variability of industry competitiveness (R^2 = 0.494). Results of the analysis are tabulated in Table 7.16, Table 7.17, Table 7.18 and Table 7.19.

7.6.1 Hypotheses Related to External Factors (H1 and H2)

The effect of two of the external forces in agri-food industry, competition intensity (H1) and environmental management practices (H2) were explored in this study in relation to supply chain performance in the beef industry. It was hypothesized that the presence of strong industry competitors in the supply chain would have a positive influence in KAM (H1a), IOS use (H1b) and inter-firm relationship strength (H1c) that indirectly would lead to a better supply chain performance. Table 7.16 shows that all three hypothesized relationships in H1 are strongly supported. The path coefficients for H1a, H1b and H1c were 0.118 (t=2.288, p.<.05), 0.121 (t=2.118, p.<.05) and 0.143 (t=2.917, p.<.005) respectively. The results provided evidence that the presence of strong industry competitors significantly influences the development of competitive assets such as KAM, IOS and strength of inter-firm relationship and, ultimately, helps achieve better performance in the supply chain.

It was hypothesized in H2 that environmental management practices would have a positive effect on the supply chain performance in the beef industry. Table 7.16 shows a t-value of 1.985 ($p>.05$) for the effect, thereby providing evidence of a significant influence in the performance of the industry.

Table 7.16 Summary of Hypothesis Testing Related to External Factors

Constructs/factors	Path	Hypothesized Relationship	Path Coefficient (β)	t - value	P - value (α)
Competitors	H1a	Competition intensity in the beef supply chain will positively influence the KAM in the beef industry in the Australian agri-food industry	0.118	2.288	0.05
	H1b	Competition intensity in the beef supply chain will positively influence the IOS use in the beef industry in the Australian agri-food industry	0.121	2.118	0.05
	H1c	Competition intensity in the beef supply chain will positively influence the inter-firm relationship strength in the beef industry in the Australian agri-food industry	0.143	2.917	0.005
Environmental management practices	H2	Environmental management practices in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry	0.104	1.985	0.05

7.6.2 Hypotheses Related to Vertical Coordination (H3)

The effect of vertical coordination was explored as an antecedent of KAM (H3a), IOS use (H3b) and inter-firm relationship strength (H3c) and it was hypothesized that the level of vertical coordination would positively influence these factors to influence the supply chain performance (see Chapter 5 for details). The results in Table 7.17 show that the path coefficient and t-value of hypotheses H3a (β=0.270; t= 5.435; p <0.000) and H3b (β 0.184; t=4.009, p <0.000) are strongly significant, thereby providing strong evidence that the level of vertical coordination has a high impact on the level of KAM and IOS use in the beef industry of the Australian agri-food industry.

Hypothesis H3c stated that vertical coordination would positively influence the inter-firm relationship strength. but it was not supported statistically by the data ($\beta=0.054$; $t= 0.949$) although the direction of the path was positive. Therefore, it can be said that the relationship strength of the beef industry is not significantly influenced by the level of vertical coordination. There could be other factors that influence the level of relationship strength.

It is important to note that vertical coordination was modelled as a higher order formative construct (molar approach) consisting of three sub-constructs/first-order constructs as indicators (Chapter 5 Section 5.3.1.1 for details)**.** The linear composites of the items of the three first-orders constructs – 'formalization of transaction' 'coordination of work' and 'contractual arrangement' were used to measure the second order construct which is described in the assessment of measurement part. Analogous to beta weights in a multiple regression, the statistical significance of the weights of the formative indicators can be used to determine the unique/relative importance of each indicator in forming the latent construct vertical coordination. The result found that the weight of coordination of work ($\beta=0.855$; $t= 13.1601$; $p<0.000$) has the highest importance followed by formalization of transaction ($\beta=0.305$; $t= 1.9424$; $p<0.05$), but the relative contribution of contractual arrangement was not significant as the beta weight was low ($\beta=0.038$; $t= 0.222$), although having a low or non-significant weight to a formatively measured higher order construct does not mean that the indicator has no absolute contribution. Loadings may indicate the importance of an indicator to a construct (Cenfetelli and Bassellier 2009). In this case, a loading of 0.429 ($p<.05$) indicates that contractual arrangement still has an important contribution in forming the second-order construct.

7.6.3 Hypotheses Related to Transaction Climate (H4)

The sentiment or relational norm in the agri-food industry supply chain was conceptualized as 'transaction climate' and modelled as an antecedent of IOS use and inter-firm relationship strength in the study. As stated in Chapter 5, it was hypothesized that a good transaction climate in the supply chain will positively influence the strength of the inter-firm relationship (H4a) and will influence the use of IOS (H4b). The Beta weight and t-values for H4a (β=0.429; t= 8.887; p<0.000) and H4b (β=0.225; t= 3.658; p<0.000), as shown in Table 7.17 strongly support the positive effect of transaction climate in 'inter-firm relationship strength' and in 'IOS use'. Therefore, it provides a strong empirical evidence of the impact of transaction climate in strengthening inter-firm relationships and use of IOS in the beef industry in the Australian agri-food industry.

Table 7.17 Summary of Hypothesis Testing Related to Vertical Coordination and Transaction Climate

Constructs/ factors	Path	Hypothesized Relationship	Path Coefficient (β)	t - value	P - value (α)
Vertical Coordination	H3a	The level of vertical coordination in the beef supply chain will positively influence the level of KAM in the beef industry in the Australian agri-food industry	0.270	5.435	0.000
	H3b	The level of vertical coordination in the beef supply chain will positively influence the level of IOS use in the beef industry in the Australian agri-food industry.	0.184	4.009	0.000
	H3c	The level of vertical coordination in the beef supply chain will positively influence the level of inter-firm relationship strength in the beef industry in the Australian agri-food industry	0.054	0.949	Not Significant
Transaction Climate	H4a	Transaction climate in the beef supply chain will positively influence the inter-firm relationship strength of the beef industry in the Australian agri-food industry	0.429	8.887	0.000
	H4b	Transaction climate in the beef supply chain will positively influence the IOS use of the beef industry in the Australian agri-food industry.	0.225	3.658	0.000

7.6.4 Hypotheses Related to Knowledge Asset Management (H5)

Hypothesis 5 tested how the development and utilization of supply chain knowledge assets influence the competitiveness (H5a) and SC performance (H5b) in the beef industry (see Chapter 5). Much like H3, the construct knowledge asset management (KAM) was abstracted in a higher-order construct and modelled as a reflective second-order construct (molecular approach instead of the formative molar approach in H3) using its five sub-constructs/first order constructs as indicators (see Chapter 5 Section 5.3.1.2 for details). The first-order constructs were acquisition and learning, memory, accessibility, shared meaning and knowledge usage. Factor score was used to compute the linear composite score of the items of each first-order construct and then used as the individual indicator of KAM. Table 7.18 reported that all loadings especially the dimensions of knowledge acquisition and learning, knowledge memory and knowledge usage were highly correlated and significant in reflecting the construct KAM.

Table 7.18 Summary of Hypothesis Testing Related to Knowledge Asset Management, IOS and Inter-Firm Relationship Strength

Constructs/ factors	Path	Hypothesized Relationship	Path Coefficient (β)	t - value	P - value (α)
Knowledge Asset Management	H5a	The level of KAM in the beef supply chain will positively influence the competitiveness of the beef industry in the Australian agri-food industry	0.304	5.535	0.000
	H5b	The level of KAM in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry	0.206	2.601	0.05
IOS use	H6a	The level of IOS use in the beef supply chain will positively influence the competitiveness of the beef industry in the Australian agri-food industry	0.028	0.667	Not significant
	H6b	The level of IOS use in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry.	-0.039	0.668	Not Significant
	H6c	The level of IOS use in the beef supply chain will positively	0.411	9.956	0.000

		influence the level of 'KAM' of the beef industry in the Australian agri-food industry			
	H6d	The level of IOS use in the beef supply chain will positively influence the level of inter-firm relationship strength of the beef industry in the Australian agri-food industry	0.111	2.459	0.05
Inter-firm relationship strength	H7a	The strength of inter-firm relationships in the beef supply chain will positively influence the competitiveness of the beef industry in the Australian agri-food industry	0.145	2.649	0.05
	H7b	The strength of inter-firm relationship in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry	0.175	2.777	0.005

The hypotheses were also supported at a high level of significance. The path coefficient and t-values for H5a in Table 7.18 indicates that KAM has a very strong positive impact on the competitiveness of the industry (β=0.304; t= 5.535; p<0.000). For the hypothesis H5b, the table also illustrates that KAM has a significant positive impact in the supply chain performance (β=0.206; t= 2.601; p<0.05) in the agri-food industry, especially in the beef industry.

7.6.5 Hypotheses Related to IOS Use (H6)

Four hypotheses were developed relating to the use of IOS and its impact in the agri-food industry. Hypotheses H6a and H6b stated that IOS use in the supply chain would positively influence the competitiveness and SC performance in the beef industry respectively. But the path coefficient and t-values in Table 7.18 show that the data do not support the hypotheses. Therefore, H6a and H6b are rejected based on the t-value of 0.667 and 0.668 respectively.

However two other hypotheses that stated the level of 'IOS use' would positively influence the level of KAM' (H6c) and the level of inter-firm relationship strength (H6d); both were supported very strongly. H6C was supported at p>0.000 (β=0.411; t = 9.956) and H6d was supported at p>0.005 (β=0.111; t= 2.459). Therefore, it can be said that IOS has a very high and significant positive impact in developing and utilizing knowledge assets, and strengthening inter-firm relationships in the beef supply chain, more generally in the agri-food industry supply chain in Australia.

7.6.6 Hypothesis Related to Inter-Firm Relationship Strength (H7)

Hypothesis H7 explored the impact of inter-firm relationship strength on performance and competitiveness in the beef industry of the agri-food sector**.** Like vertical coordination in H3, the inter-firm relationship strength construct was developed as a formative second-order construct (molar approach) using five dimensions of sub-constructs/first-order constructs as indicators (see Chapter 5 Section 5.3.1.2 for details). Factor score was used to compute the linear composites of the items of the first-order constructs of mutual investment, commitment, contract choice, interdependence and trust. The individual composite score of each of the five first-orders were then used as formative indicators to measure the higher order construct inter-firm relationship strength. The main purpose of this formative model was to extract the beta weight of each of the first orders to realize their relative contribution in forming the second-order latent construct, and to determine how the mediated strength impacted on SC performance and competitiveness. As reported in Section 7.5.1.1**,** the sub-construct of commitment has the highest importance (β=0.628; t = 8.0732; p<0.000) in forming relationship strength, followed by mutual investment (β=0.402; t = 6.203; p<0.000), trust (β=0.305; t = 4.4251; p<0.000), and interdependence (β=0.198; t = 2.0597; p<0.05). The sub-construct contract *choice* had a negative and insignificant weight (β= -0.037; t = 0.604) and, therefore, was not significantly associated with the relationship strength. However, it has been argued that a negative indicator weight does not mean an overall negative effect on the formatively measured construct (Cenfetelli and Bassellier 2009); this is because of the pattern of correlations among the indicators where suppression may occur if an indicator shares more variance with another indicator in another construct. Moreover, the indicator that has a low beta weight may have an important contribution in terms of the bivariate correlations or loading with the construct. In the current study, a check of bivariate correlations found that contract *choice* had a significant correlation with inter-firm relationship strength.

The higher-order effect of the relationship construct was tested then in regard to supply chain performance and competitiveness. The result of the structural model, as shown in Table 7.18, provided strong evidence for both hypotheses; H7a (β= 0.145; t = 2.649; p> 0.05) and H7b (β= 0.175; t = 2.777; p<0.005). Thus, it can be said that strength of inter-firm relationships in the supply chain significantly influence the competiveness and supply chain performance in the beef industry of the Australian agri-food industry.

7.6.7 Hypotheses Related to Price Uncertainty (H8)

Hypothesis H8 examined how price uncertainty influences the inter-firm relationship strength (H8a) and supply chain performance (H8b) in the beef industry of the agri-food industry. It was hypothesized that price uncertainty would negatively influence the relationship strength (H8a) and performance (H8b) in the supply chain**.** The result in Table 7.19 shows that, although the direction of the relationship in hypothesis H8a was negative (β= -0.025; t = 0.566), the path coefficient and t-value did not statistically support the view that price uncertainty has a significant negative influence on inter-firm relationship strength. The other hypothesis in H7b tested the impact of uncertain price in SC Performance; the result (β= -0.178; t = 3.395; p<0.000) strongly supported the hypothesis and it was concluded that price uncertainty has a high negative impact in supply chain performance.

Table 7.19 Summary of Hypothesis Testing Related to Price Uncertainty, Negotiation Power and SC Performance.

Constructs/ Factors	Path	Hypothesized Relationship	Path Coefficient (β)	t - value	P - value (α)
Price Uncertainty	H8a	Price uncertainty in the beef supply chain will negatively influence the inter-firm relationship strength of the beef industry in the Australian agri-food industry	-0.025	0.566	Not significant
	H8b	Price uncertainty in the beef supply chain will negatively influence the SC performance of the beef industry in the Australian agri-food industry	-0.178	3.395	0.000
Negotiation Power	H9a	Negotiation power in the beef supply chain will positively influence the inter-firm relationship strength of the beef	0.217	4.487	0.000

		industry in the Australian agri-food industry			
	H9b	Negotiation power in the beef supply chain will positively influence the SC performance of the beef industry in the Australian agri-food industry	0.197	3.517	0.000
SC performance	H10	SC performance of the Australian beef supply chain will positively influence the competitiveness of the industry.	0.0.412	10.273	0.000

7.6.8 Hypotheses Related to Negotiation Power (H9)

Hypothesis H9 examined the impact of negotiation power on inter-firm relationship strength and SC performance. Hypothesis H9a posited that the negotiation power of supply chain participants in the agri-food industry especially in the beef industry would positively influence the inter-firm relationship strength in the industry. The path coefficient 0.217 and t-value of 4.487 was significant at $p<0.000$. Thus, strong empirical evidence indicated the positive influence of negotiation power in strengthening inter-firm relationships. Hypothesis H9b, that predicted a positive influence of negotiation power in supply chain performance, was also strongly supported by the data ($\beta= 0.197$; $t = 3.517$; $p<0.000$).

7.6.9 Hypothesis Related to SC performance (H10)

The final hypothesis was related to the consequences of the SC performance to the overall competitiveness of the industry. It was hypothesized that given the effect of antecedents in the research model, SC performance would positively influence the competitiveness of the industry (H10). Like vertical coordination (H3) and relationship strength in the model, SC performance was also designed as a formative higher order construct (molar approach) using linear composites of two sub-constructs/first-order constructs as indicators. As discussed in the Section 7.5.1.1, the internal facing construct measuring the internal performance had the highest importance ($\beta= 0.679$; $t = 7.792$; $p<0.000$) in forming the latent construct, followed by customer facing ($\beta= 0.456$; $t = 4.5327$; $p<0.000$), although both the first-orders were highly significant in contributing to SC performance.

The effect of SC performance, then, was tested in regard to the competitiveness of the industry. Table 7.19 shows the strong empirical evidence that supports hypothesis H10 (β= 0.412; t = 10.273) at the significance level $p<0.000$.

7.7 Summary

This chapter has described the process of analyzing the survey data and testing the research hypotheses using partial least square (PLS) based structural equation modelling (SEM), a confirmatory second-generation multivariate analysis tool. A telephone survey methodology was used to collect data from the two Australian states of Western Australia (WA) and Queensland (QLD). The beef industry, as a most important part of the Australian agri-food industry, was chosen as the sample industry to test the research model. Data were collected by categorizing the sample firms as beef-cattle producers, processors, retailers/exporters, wholesalers and input suppliers. The CATI (Computer Aided Telephone Interviewing) system was used to conduct the interviews and made administering different versions of the questionnaire to different categories of people very easy. Using a quota system of a minimum of 30 and a maximum of a hundred in each of the three main categories of respondents, a total of 315 valid responses was produced.

The chapter described in detail how the research model was assessed in both the measurement (the relationship between latent construct and its measurement items) and structural (the hypothesized relationship between latent construct) parts. Using the procedure of confirmatory factor analysis in PLS, the measurement part detailed the assessment of convergent and discriminant validity of the reflective and formative constructs and their contribution in a second-order model. The assessment was conducted in three steps: i) reliability of the measurement item, ii) internal consistency of the item as a group, and iii) discriminant validity both at the indicator and construct level.

In the structural part, hypotheses were assessed based on the path coefficient (beta weight) and t-value of each hypothesized path generated from PLS bootstrap analysis. The statistical results showed that of the 22 proposed hypotheses, 18 were supported by the data. The results indicated that knowledge asset management-KAM was the strongest predictor of SC performance, followed by negotiation power, price uncertainty, inter-firm relationship strength and environmental management practices. The results also showed that, given the effects of antecedents, SC performance strongly influences the competitiveness of the industry. The R^2 values indicated that the model has adequate merit in that it explains over 25 percent of the variance in all the endogenous constructs while a large GoF value indicated a relatively parsimonious model.

Chapter 8

Discussion and Implications of Results*

8.1 Introduction

This chapter follows on from Chapter 7 to explain and interpret the results of the data analyses and the testing of research hypotheses (proposed in Chapter 5) using PLS based structural equation modelling. It also includes discussion of the implications of the results, the significance of each of the research factors and constructs in the performance and competiveness of the industry and offers recommendations about benchmarking the practices.

8.2 Discussion and Implications of the Data Analysis

The research model was assessed based on 315 valid sample cases collected through a telephone survey of the beef industry of Western Australia and Queensland. As shown in Chapter 7, all constructs related to the research hypotheses were found to have high levels of reliability and validity. The confirmatory factor analysis in the assessment of the measurement model provided a rigorous and systematic test of the factor structure. The test demonstrated that all the first orders and reflective constructs were valid, reliable and uni-dimensional. It also showed that all the second-order multi-dimensional constructs satisfied the benchmarks applied in this study**.** The squared correlation coefficients, both at the item and construct levels, supported the appropriateness of the structure of the conceptual model (see Section 7.5.1.3). The assessment showed that all the first-order constructs contributed significantly in forming the second-order latent constructs (either by formative

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* Part of this chapter has been presented at the following conferences:

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Knowledge asset and inter-organizational relationship in the performance of Australian beef supply chain, in *Proceedings of the Fourteenth Pacific-Asia Conference on Information Systems (PACIS)*, 9-12 July, 2010, Taipei, Taiwan.

Uddin, M.N., Quaddus, M. and Islam, N. 2010. Inter-firm relationships and performance factors in the Australian beef supply chain: Implications for the Stakeholders, in *Proceedings of the Australian Agricultural and Resource Economic Society (AARES) National conference,* 10-12 February, 2010, Adelaide.

weight or reflective loading), except two of the first-order constructs - *contractual arrangement* and *contract choice* did not have significant formative weights for the vertical coordination and inter-firm relationship strength constructs respectively. The results established that vertical coordination significantly depends on the level of inter-firm coordination and formalization of transactions, while relationship strength depends on the level of mutual investment, trust, commitment and interdependence of the firms participating in the supply chain.

Assessment of the structural part demonstrated that 18 of the 22 hypotheses made from 11 primary factors and 15 sub-factors, were supported. Thus, the results indicated that respondents considered a majority of the factors to be important in supply chain performance and competitiveness in the industry. Among the predicting factors that have a direct path to supply chain performance, the results showed that knowledge asset management is the strongest predictor of supply chain performance. The level of negotiation power, price uncertainty, inter-firm relationship strength and environmental management practices also significantly influence the supply chain performance in the industry. However the data did not support the hypothesis that IOS use has a significant influence in supply chain performance and competitiveness in the agri-food industry, although, the other two relationships IOS → KAM, and IOS→ inter-firm relationship strength were supported significantly.

Assessment of the model also indicated some significant determinants of KAM, IOS use and inter-firm relationship strength. Results showed that the presence of industry competitors, vertical coordination and transaction climate – all exogenous factors – had a significant influence in KAM, IOS use and inter-firm relationship strength, except that vertical coordination did not have a significant effect in inter-firm relationship strength. Finally, the total effect (indirect + direct) of the supply chain performance had a very strong positive impact in achieving the competitiveness/competitive advantage in the industry, indicating a strategic priority for improving the supply chain.

The following sections further discuss the effects, importance and implications of each of the exogenous and endogenous supply chain performance factors in the beef segment of the Australian agri-food industry.

8.2.1 External Factors in the Supply Chain Performance (H1 and H2)

It was hypothesized that two of the external factors, presence of industry competition and environmental management practices in the supply chain would have a positive impact on the performance of the beef segment of the Australian agri-food industry. Hypothesis H1 assessed the affect of competition intensity on the level of KAM, IOS use, and relationship strength and, consequently, their indirect influence in the supply chain performance. Hypothesis H2 explored the direct affect of environmental management practices on the performance of the supply chain.

Hypothesis H1

Hypothesis H1 was split into three sub-hypotheses to assess the effect of competition on three important elements of supply chain performance; KAM, IOS use and inter-firm relationship strength. The results presented in Table 7.1 showed that all three hypotheses of H1a (competition → KAM β 0.118, t=2.288, p<.05), H1b (competition →IOS, β 0.121, t=2.118, p<.05) and H1c (competition → relationship strength, β0.143, t=2.917, p<.005) were supported. Therefore competitors have a significant role in developing and maintaining the level of strategic assets such as KAM, IOS, and relationship strength in the supply chain in order to achieve better performance and competitiveness in the industry. This finding is consistent with previous studies that reported competitors have a significant role in determining strategic goals and enhancing the ability of an industry to differentiate itself from other industries (Allon and Federgruen 2007; Buchko 1994; Porter 1985; Saeed *et al.* 2005; Tsay and Agrawal 2000; Xia and Yang 2008). These studies showed that the relative intensity of competition plays a key role in the degree of knowledge asset and information systems application and the degree of cooperation in buyer-supplier dyads. The findings also supported the results of the field study that showed both national and international competitors drive the business strategy of Australian food companies, especially the production and sales strategies of processors and retailers. Intense competition enables them to harness highly sophisticated knowledge management, inter-organizational systems and relationship structures in the supply chain. The field study also revealed that the absence of competition can degrade productivity and profitability in the long run, such as in the case of primary beef producers. For example, the absence of competitive marketing strategies places obstacles to the growth of successful cooperatives and coordinated operations among WA primary producers. They experience a knowledge gap in market-driven operation/value-adding activities in the supply chain (Uddin, Quaddus and Nazrul 2010b; WY and Associates 2009). Thus, being dependent on a small domestic market with only a small percentage of exports, WA producers become price takers and suffer from cost competitiveness and profitability problems compared to eastern states producers who are more vertically integrated and competitive. As market forces drive sustainable change, the business operation should be able to adapt to the existing competition; the battle should be between competing groups or competing supply chains for a share of the market (WY and Associates 2009). Firms should position themselves within a part of a supply chain to compete against other supply chains, rather than as a single firm competing with other firms (Boyaci and Gallego 2004; Tsay and Agrawal 2000; VanderVorst and Beulens 2002). These studies indicate that market share depends on the service/cost of one channel while the retailer is in the rival channel; therefore, the implication is that all the supply chain participants should run profitable operations knowing their value-added cost and market forces, where economies of scale and low costs of production can be achieved. Establishment of close linkages and alliances with key industry players to cooperate in certain functional areas and the development of a channel marketing approach through a competitive supply chain knowledge, inter-organizational system and relationship structure can create both horizontal and vertical competition to improve profitability in the industry.

Hypothesis H2

Testing of the model also provided support for hypothesis H2 (environmental management → SC Performance, β 0.104, t=1.985, $p<.05$). Therefore, it can be said that environmental management practices in the supply chain can influence its performance positively. The result is in line with the literature; positive animal welfare and environmental management can provide considerable social and economic benefits (Blythman 1988; Hall 2000; Hampson and Johnson 1996; Jones 2002; Lamming and Hampson 1996; Pretty 1998; Triebswetter and Hitchens 2005). It also supports the field study findings that showed waste management practices and reduced carbon emission can enhance market access, business reputation and performance. The result has several implications. Incorporation of the factor environmental management practices in the agri-food industry supply chain combining the elements of animal welfare and efficient use of power/water resources was stemmed from the field study findings of growing consumer pressure to improve environmental management, food safety and animal care. Domestic and overseas consumers increasingly are demanding assurance that animals used for food are treated well and that carbon emissions are kept to a minimum when the foods are transported. It has been argued that these practices and associated regulations enhance innovation in the firm, which may lead to significant cost and resources savings, and may contribute to creating a positive corporate image; they can provide a competitive advantage in accessing markets and improving performance (Hitchens, and Triebswetter 2005; Schmidt, Møller and Øllgaard 2001; Tsoulfas and Pappis 2008). However, there has been a debate regarding the direct cost of policies for the industry compared to their impacts on economic growth and international competitiveness (Jaffe *et al.* 1995; Jorgensen and Wilcoxen 1990). Testing empirical data of the potential effect in hypothesis H2 established that there were win-win opportunities through animal welfare and waste management practices. On one hand, they reduced carbon food-miles/fuel use and pollution and, on the other hand, enhanced corporate image (through a closer communication with customers, other interest groups and society in general), business access and productivity. Moreover, Triebswetter and Hitchens (2005) showed that the costs associated with maintaining an environmental image are not an important factor in the survival or growth of sample firms. They also argued that although the costs varied widely, depending on the type of industry and geographical coverage, there was no evidence that existing environmental regulations prevented firms from achieving competitive performance. Instead, there is evidence that, in addition to meeting the regulatory requirements, addressing the environmental issues targeting specific consumer interest or pressure groups can lead to supply chain innovations (Hall 2000).

8.2.2 Vertical Coordination in Supply Chain Performance (H3)

The hypotheses related to the impact of vertical coordination in supply chain performance were mainly derived using the framework of Transaction Cost economics (TCE). The field study results also were used to hypothesize about the theoretical relationships and develop the construct in a second order model. Justification for the hypotheses was drawn from the literature on TCE framework and vertical supply chain competition that dates back to the classic work of Spengler (1950) who argued that decentralized decision-making between a supplier and retailer can result in a higher retail price (Boyaci and Gallego 2004.**)**.

Based on the work of Clare, Reid and Shadbolt (2005), Duffy (2008), Hobbs and Young (2000), Nidumolu (1995), Peterson and Wysocki (1997), and Schulze *et al*. (2006), the construct vertical coordination was created in a composite molar/formative construct using three dimensions of sub-construct/first-orders constructs, viz., coordination of work, formalization of transaction and contractual arrangement (discussed in Section 5.4.1.1). Although considerable research has been done on individual dimensions of this construct, the concept has never been tested by aggregating the overall domain of the construct to investigate its affect on the supply chain. The current research showed that the formative weights of coordination of work (β=0.855; t= 13.1601; p<0.000) and formalization of transaction (β=0.305; t= 1.9424; p<0.05) made the most important contribution in formulating the higher order concept vertical coordination. Although the path coefficient of contractual arrangement was very low and non-significant, the loadings 0.429 (p<.05) showed that it also makes an important absolute contribution to vertical coordination. The result has several important implications: e.g., the level of coordination, such as sales and distribution of product, information sharing and asset specific investment; the level of formalized transactions such as short-term and long-term contracts (rather than open market transactions); and, finally, the level of contract specification regarding production practices or controlling full production of the suppliers are significantly important in organizing and governing a vertical relationship.

Hypothesis H3 was split into three sub-hypothesis (described in Chapter 5 Section 5.5.2). It was proposed that the level of vertical coordination in the supply chain would positively influence the level of KAM (H3a), level of IOS use (H3b) and the level of inter-firm relationship strength (H3c) and, consequently, influence supply chain performance. Strong support was found for hypotheses H3a (vertical coordination. → KAM, β=0.270; t= 5.435; p <0.000) and H3b (vertical coordination.

→ IOS, β 0.184; t=4.009, p <0.000) that vertical coordination can influence the level of knowledge asset management and the level of IOS use. This finding was expected and in line with extant literature. It supports the idea that coordination mechanisms can integrate the specialist knowledge of the supply chain members (Ghoshal and Moran 1996; Grant 1996; Hult *et al*. 2006) and can improve the information flow, given that open markets are able only to pass on quality-related information in food chains to a very limited extent (Hennessay 1996; Hobbs and Young 2000, Lawrence, Grimes and Hayenga 1998; Schulze, Spiller and Theuvsen 2006). It also supports the field study finding that supply chain members in the agri-food industry can benefit from vertical coordination for their reliance on explicit information and knowledge about high quality differentiated products valued by consumers. For example, based on the current market trends, a beef producer may need advance information on feeding, animal health and biological attributes of the product to make necessary adjustments in farming methods leading to carcass development within a targeted quality and cost. On the other hand, processors and retailers need to know the quality attributes and markets of these products with detailed information about where and how the product was produced. Vertical organization and information sharing can integrate such knowledge from many different individuals in the supply chain and can provide a basis for a better performance across the supply chain.

While the influence of vertical coordination in KAM and IOS was found highly significant, its influence in inter-firm relationship strength in H3c was found to be not significant (vertical coordination → relationship strength, β 0.054; t=0.949). Although the direction of the relationship showed that some influence exists, it did not support the proposition statistically, which indicated there may be some other possible explanation and implications for a sustained performance in the supply chain. There are several methods of vertical coordination or governance structure of transactions that may range from open market transaction, specification contracts, relation-based alliances, equity-based alliances through to full vertical integration. Inter-firm relationship strength should depend on the levels of this coordination. Transaction cost economics (TCE) suggest (Williamson, 1985; Hobbs and Young 2000) that in a buyer-supplier relationship the choice of a particular method depends on economic rationality such as when transaction costs (the cost of searching for a reliable buyer/seller, negotiating and monitoring contracts) are low and use of an auction or open market system increases; but when the costs are high, it is efficient to carry out the transaction by a specific contract, a strategic alliance (relation-based alliances/equity-based alliances) or by fully integrating the firms in a vertical relationship. The evidence from the field study demonstrated a low level of vertical coordination and dominance of the use of open market systems in the Australian agri-food industry. One possible reason is that this low level of coordination cannot influence the strength of inter-firm relationships and can be dependent on other factors such as the level of trust, mutual investment, commitment and interdependence in the vertical relationship. In an open market system, trust and commitment often are very low, while in vertical integration the intensity of trust and commitment are very high (Clare, Reid and Shadbolt 2005; Duffy 2008; Peterson and Wysocki 1997).

Evidence of the impact of vertical coordination on the beef industry can be adduced further by investigating the current market structure of the industry and its governance in the WA and QLD supply chains. For this purpose, survey data were analysed using independent-samples t-test to compare the means of the results between the states (WA and QLD) and between the groups (producers, processors and retailers). Although nonparametric tests have been used throughout this study, independent samples t-test is ideal for this situation, irrespective of sample population distribution, because the sample size is greater than 30 (Jackson, 2007). In Table 8.1 important issues and a comparative picture between WA and QLD are presented, showing standard means (from a seven-point scale) and the relative significance between the means. The table shows that coordination in transactions, such as sale dates and delivery schedule, open/auction market use and sharing of information had the highest mean scores of above 4.0 (total mean), while asset specific investment and the presence of short- and long-term contracts and contract specifications had the lowest mean scores of below 3.0. This indicated a low level of relationship strength.

Table 8.1 The Market Structure

Items/Issues		Producer WA=83, QLD=49		Processor WA=32, QLD=65		Retailer WA=48 QLD=34			
Coordination and sharing		Mean	Sig.	Mean	Sig.	Mean	Sig	Total Mean	Sig.
Coordination in transaction such as sales date, delivery times between buyers and sellers	WA	4.92	**.030**	6.13	.766	6.02	.222	5.50	**.006**
	QLD	5.55	**.020**	6.05	.768	6.32	.197	5.95	**.005**
Asset specific investment	WA	1.93	.913	1.91	.124	2.38	.407	2.07	.409
	QLD	1.96	.918	1.45	.183	2.03	.394	1.75	.409
Sharing of information that affects the buyer-seller business	WA	3.41	.039	4.91	.067	4.21	.811	3.95	.409
	QLD	4.10	.043	4.09	.072	4.32	.812	4.13	.409
Method of marketing/Formalization of Transaction									
Use of auction, or open market	WA	5.01	.841	4.06	.211	5.33	.114	4.93	.326
	QLD	4.94	.843	4.65	.223	4.56	.118	4.69	.327
Use of short-term contract	WA	2.65	.831	2.75	.271	2.26	.122	2.65	.251
	QLD	2.73	.831	3.19	.286	2.92	.145	2.91	.249
Use of long-term contract	WA	1.96	.898	2.74	.082	2.65	.815	2.46	.783
	QLD	2.00	.901	3.63	.077	2.77	.815	2.53	.783
Contract specifications (in a contractual relationship)									
obligation of marketing suppliers production	WA	2.53	.873	2.20	**.006**	2.71	.579	2.43	.194
	QLD	2.59	.871	3.47	**.002**	2.44	.573	2.73	.196
Specifying suppliers production practices and quality of production	WA	2.87	.116	4.47	**.026**	3.00	.516	3.21	.458
	QLD	3.55	.126	3.32	**.025**	3.35	.516	3.41	.458
Having full control on suppliers production	WA	1.76	.067	1.88	.326	2.23	.423	2.02	.209
	QLD	2.29	.093	2.25	.296	2.62	.424	2.28	.212

Significant differences are indicated by the shading

The open/auction market is still the dominant means of buyer-seller transactions in the beef industry of both WA and QLD. It has the highest mean score of 4.93 (WA) and 4.69 (QLD) compared to short-term (WA=2.65; QLD=2.91) and long-term contracts (WA=2.46; QLD=2.53). Although there were no significant differences between the states, the QLD position is a bit stronger, having more contractual relationships and less use of the auction market.

Prior studies have shown that the Australian beef industry is mostly supply driven, while the firms that align production with specific market needs run successful operations (WY and Associates 2009). In WA, the beef industry is more fragmented and made up of a large number of independent small-to-medium producers and processors and one large processor – Harvey Industries group, while in QLD, although the beef industry has some forward and backward integration to optimize market choices, production is still concentrated in the top 20 percent of producers responsible for producing 80 percent of the total output. Vertical integration and development of a beef brand is still not a key element in some of these top companies' marketing strategies. Table 8.1 presents the evidence; a low mean score of the contractual relationships and contract specifications such as buyer obligation in marketing the supplier products (WA=2.43; QLD=2.73), specifying quality and production practices (WA=3.21; QLD=3.41) and having full control of the suppliers' production (WA=1.76; QLD=2.29). Again, while the data shows more integration in QLD compared to its WA counterparts, there are no significant differences between the states in terms of contract specifications and formation of integrated supply chains from the breeding stations through to the final customers.

While comparing the data among groups of supply chain participants - producers, processors/exporters and retailers/wholesalers, Table 8.1 shows some differences between the groups and between the states. For example, WA and QLD producers are significantly different in terms of the level of coordination in transaction (WA=4.92; QLD=5.55) and sharing of information (WA=3.41; QLD=4.10). Comparison across the categories shows that processors' attitudes to the coordination of transactions and sharing of information are more positive compared to those of producers, although no significant difference was found between the processors and retailers. The result is in line with a study of WA Farmers (2009) that found WA cattle producers are fiercely independent. They do not readily accept the concepts of sharing resources and information or innovative ways of developing profitability, which is an obstacle to flourishing the WA beef industry. Therefore, it is suggested in this study that attitudinal and structural changes are needed for these producer farms to change effectively from being commodity-focused and production-pushed, to being market-focused and market-driven (WY and Associates 2008, p. viii). This is also important for the commercial viability and adaptability of the producers and other players in the supply chain in a rapidly changing market, where consumers dictate both domestic and export markets conditions (WY and Associates 2009, WA Farmers 2009). As vertical coordination is crucial to developing a market-driven supply chain, these producers can be linked in the mainstream supply chain for adjacent stages of the value adding processes, but still preserve their ownership autonomy, unlike what occurs in vertical integration (Macneil 1980; Williamson 1991). They can work under a bilateral/relational contract with identified social and economic relationships such as information sharing and pricing strategy to establish the profitability of all parties.

In Table 8.2, an attempt is made to disaggregate the nature of transactions of the beef industry into a series of components in order to develop coordination/contracting models for the supply chain participants. To understand the nature of coordination required, the supply chain of the Australian beef industry can be depicted as breeding → back-grounding →feed-lotting → processing → marketing, based on the movement of a newborn calf through the various sectors to being a marketable product (WA Farmers 2009). The transaction/supply chain costs of the industry also can be summarized as the producer costs such as stock, grazing, land, labour, grain, fertilizer and fuel; processor costs such as kill, processing, boning into primals,

Table 8.2: Modelling the Nature of Governance and Coordination Structure between Producers and Processors/Retailer/Exporters.

	Contractual Perspective	**From Beef Producers to Processors/Retailers/Exporters**
	Objectives	To supply beef according to the market needs
Nature of transactions	Volume/frequency of transaction	Very frequent, large volume in season
	Environmental, political social or economic risk (Uncertainty)	Considerable – being an agricultural product, seasonality, unpredictability and demand of consumers
	Dedicated inputs (Asset specificity)	High – land, labour, grain and fertilizer cost.
	Limited judgement (Limited capacity of decision making under incomplete or partial information)	High – with limited knowledge of markets, prices, and qualities.
	Opportunistic behaviour (Self	Considerable – processors and retailer have ultimate

	interest)	market power. Supermarkets are closely regulated and trusted.
Governance	Actual	Trilateral[5] – contracts are built with safeguards and identified arbitration (neoclassical contract law) to schedule production, quality, and volume of the beef.
	Expected	Relational/bilateral[6] seeks continuity of contract but with the autonomies of the parties. This can reduce transaction costs by joint planning and strategies.
Contracting process		Neo-classical[7]

Source: Adapted from Williamson (1985, 1991); Banerjee (2004); Loader (1997).

packaging and chiller; and finally, distribution and retail costs such as transporting, slicing and trimming of primals, packaging, labour, advertising and store cost. In the absence of a highly coordinated supply chain, the value added cost and price of the beef increases up to 80 percent at retail sale compared to the farm gate price (WA Farmers 2009).

Based on the aforesaid nature and value-added cost of the supply chain, the first part of Table 8.2 summarizes the relationship/transaction objectives under consideration. The second part summarizes elements of transactions from Williamson (1985, 1991). It shows that producers operate in a high degree of uncertainty and require extensive input costs. Lack of information and knowledge about current market trends results in producers having a limited capacity for decision-making, while opportunistic behaviour exists in the market because of the imbalance in producers' power compared to that of processors and retailers. Given the level of these transaction elements, the third and fourth parts provide an expected governance/coordination structure in the contracting process, compared to what actually occurs in the particular situation. However, it is still imperative to steady the relationship, based on

[5] Trilateral contracts are built with safeguard and third party assistance (arbitration) in resolving disputes and evaluation performance is employed (Loader, 1997).

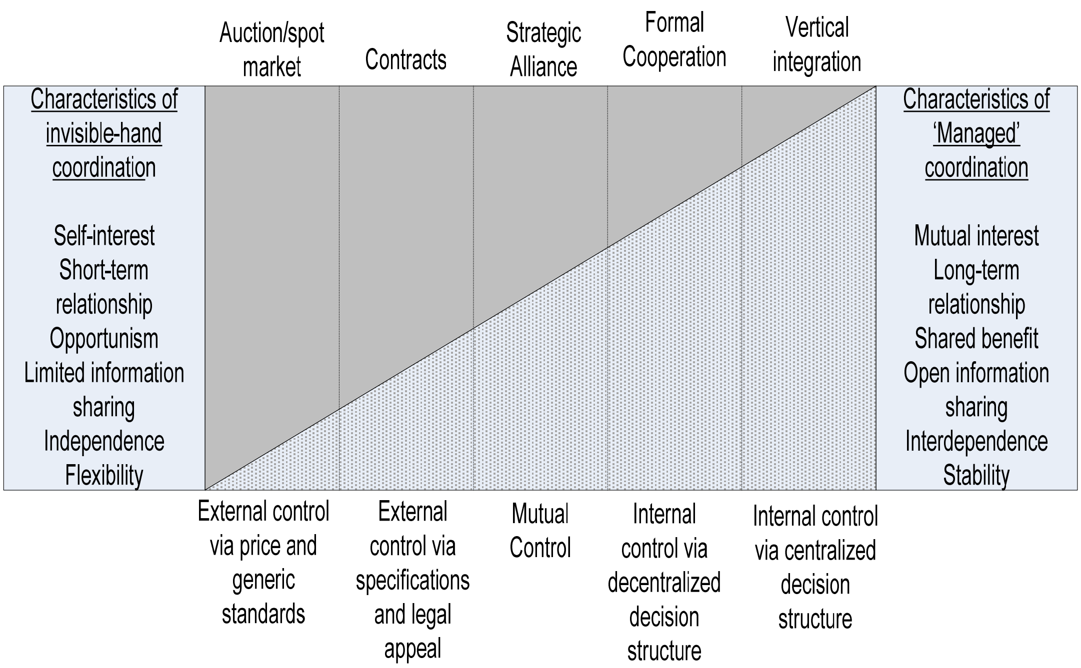
[6] Relational contracts are continuing contracts between parties where a range of social and economic relationships help to define and support a range of transactions (Loader, 1997, p. 26).

[7] Neoclassical contract law relieves parties from strict enforcement. It applies to contracts in which the parties to the transaction maintain autonomy but are bilaterally dependent to a nontrivial degree. It recognizes that the world is complex, that agreements are incomplete, and that some contracts will never be reached unless both parties have confidence in the settlement machinery (Williamson 1985, p. 70; Williamson 1991, pp. 271-272; Banerjee, 2004, p.8)

trust and commitment, for a profitable outcome to be achieved for all the parties involved.

Peterson and Wysocki (1997) provided a continuum of vertical coordination strategy, which is equally applicable in the Australian agri-food industry. As shown in Figure 8.1, five categories of vertical coordination strategy were suggested. The beginning of the continuum, the auction markets, indicate the lowest level of coordination and the end of the continuum, vertical integration, indicates the highest level of coordination. In the absence of a proper level of coordination, the characteristics of market transactions are listed at the beginning as invisible-hand coordination, which follows self interest, opportunistic behaviour, limited information sharing and so on. When an appropriate level of coordination exists, the characteristics of transactions are listed at the end of the continuum as managed coordination. This is built upon mutual interest, long-term relationships, shared benefits and so on. Figure 8.1 also suggests that, as the coordination strategies move from left to right, the domination of the coordination characteristics moves through a changing mix of invisible-hand/managed characteristics. The diagonal line represents the mix where the area above the line indicates the relative level of invisible-hand characteristics and the area below the line indicates the level of managed characteristics.

Figure 8.1 A Vertical Coordination Continuum for the Beef Industry



Source: Adapted from Peterson and Wysocki (1997)

Finally, it was concluded that the aforesaid two models are applicable to different types of supply chain in the beef industry/agri-food industry in Australia. These can be classified as: a mainstream supply chain led by the supermarket retailers; direct marketer supply chain led by producer groups to supply directly to consumers/niche markets; and an intermediate supply chain for the local product that reaches consumers through one or more intermediaries such as supermarket retailers, independent butchers and food cooperatives. Typically, the mainstream supply chain provides information on how a product is produced, such as organic or hormone free, for which they rely on their suppliers and need coordination strategies. But usually it lacks meaningful links to consumers, whereas a direct marketer or local beef chain can utilize this opportunity. An alliance can be developed to achieve this additional marketing leverage based on some common goals or values that may include a health and management program, a specific breed, a geographic identity or an emphasis on leanness. For example, a vertical alliance among the producers, breeders, feedlot operators and packers can add value to beef for a particular market such as Angus beef and increase the members' marketing leverage, resulting in bigger margins, flexibility and ability to supply stock at the times of year when others cannot. The members of this type of alliance can get help in feeding and in obtaining the required genetic attributes of the cattle. But they can retain ownership under an agreement where payment will be made based on pre-determined quality and weight specifications. For the small producer selling in the conventional market, a cooperative calf pool is a great way to get the best possible price.

8.2.3 Transaction Climate in Supply Chain Performance (H4)

Hypothesis H4 was split into two sub-hypotheses. It examined how the climate of inter-firm transactions influences the strength of inter-firm relationships (H4a, transaction climate → inter-firm relationship strength) and the use of inter-organizational systems (H4b, transaction climate → IOS use) in the performance of the supply chain. Transaction climate represents the behavioural and social elements of inter-firm relationships such as mutual understanding, compatibility of each other's goals and fairness in sharing the risk and benefit from the relationship. The assessment of the model in Chapter 7 showed that within H6, both sub-hypotheses were supported at a high level of significance. Moreover, transaction climate was the strongest predictor of developing inter-firm relationship strength (β=0.429; t= 8.887; p<0.000) and the use of IOS (β=0.225; t= 3.658; p<0.000) in the supply chain. This finding was expected as a number of studies have supported the view that positive climate in a relationship is a robust predictor of inter-firm cooperation and enhanced inter-organizational system adoption, information exchange and relationship performance (Bensaou 1997; Clare *et al.* 2005; Duffy and Fearne 2004; Grover and Malhotra. 2003; Reve and Stern 1976).

Also, the findings are in line with the notion of RBV and TCE because, in addition to structural factors (e.g., asset specificity and vertical coordination), transaction climate can be considered as an intangible and non-tradable asset because mutual understanding and symmetry in the relationship reduce opportunistic behaviour, protect the relation-specific investment and save the costs of monitoring contractual performance of the exchange partners (Dwyer, Schurr and Oh 1987; Grover and Malhotra 2003; Heide 1994; Williamson 1985). The results also are in line with other studies showing that coercive pressure from powerful supply chain partners can negatively influence IOS adoption and supply chain performance (Patterson, Grimm and Corsi 2003; Premkumar 2000). For example, during the field study one supermarket retailer said that they usually invite the suppliers to view their (retailer) facilities, and discover of what they exist and how they operate, thereby reducing unexpected problems and friction. They believe that, as buyers, they should be aware of the limitations of suppliers, whereas suppliers should also know the effects of noncompliance with the contracted quality and quantity of supply. Broader understanding of each other helps both parties work more cohesively and increase performance. It also gives them confidence to source products, sometimes with just three days notice, before they are needed the product. Better understanding also has an immense impact in reducing the need to maintain excessive stocks in the store, improving the quality of the product like fresh beef or specific cuts of the meat, and eliminating the probable cost of transactions with new suppliers.

8.2.4 Knowledge Asset Management (KAM) in Supply Chain Performance (H5)

Hypothesis H5 tested how knowledge asset management (KAM) in the supply chain impacts on competitiveness (H5a) and supply chain performance (H5b) in the beef industry in the Australian agri-food industry. KAM is tested as a higher order construct and measured using five sub-constructs: acquisition and learning, knowledge memory, accessibility, shared meaning and knowledge usage. Unlike vertical coordination in H3, they were measured in a reflective direction. The loadings (correlations) showed that knowledge usage (0.876), knowledge memory and the dynamic capabilities of knowledge acquisition and learning had the highest importance in knowledge asset management in the supply chain. Shared meaning of knowledge (0.772) and accessibility to knowledge (0.689) also had a significant relationship in reflecting KAM.

Findings from the structural model assessment revealed that knowledge asset management has a strong positive affect on competitiveness (β=0.304; t= 5.535; $p<0.000$) and supply chain performance (β=0.206; t= 2.601; $p<0.05$) in the beef industry. This is consistent with the insight of resource-based/knowledge-based theory and the related literature (for example, see Barney 1991; Bogner and Bansal 2007; Bueno, Anton and Salmador 2008; Grant 1996; Hult *et al.* 2006; Ketchen and Hult 2007; Johnston and Paladino 2007; Pitelis 2004). In these studies it has been argued that the supply chain requires continuous information and knowledge sharing activities to maintain its strategic and operational outcomes. Knowledge is usually treated as an intangible asset and a strategic resource in the supply chain as it provides access to efficient inter-firm transactions, markets of inputs and outputs and, subtly but determinedly, steers members toward satisfying customers' needs (Nooteboom 2004). The capacity of learning, accessibility and exploitation of knowledge through cooperative efforts in the supply chain, especially in the process of production and marketing, enhance organizational innovations, outcomes and sustained firm performance (Hult, Ketchen and Slater 2004). For example, based on historical data, feedback and experience with inter-firm relationships, associated contracts and carcass compliance in the supply chain, a producer firm can identify problems and opportunities to increase its profitability, reduce the impact of seasonal variations in carcass characteristics and make adjustments in farming for moving to a particular production system or breeding regime for a particular market (niche market).

The results also support the field study findings that knowledge can be an important source of chain coordination, chain functioning and innovation from upstream producers to downstream processors and retailers by reducing unexpected friction in the relationship. For example, the guidelines and feedback that the beef producers receive from their processor/abattoirs for each animal they send for processing help to mitigate issues of carcass weight and price. Similarly, the market intelligence that processing companies collect helps them to bargain with their larger buyers (such as supermarket retailer) to gain strategic focus on sales and profit. The study also found that processing and retailing companies generate knowledge from their internal purchasing and sales data to learn more about the markets, the customers, and their demand and supply characteristics. This knowledge affects everything down the line; viz., production, logistics and purchasing of the inputs. In a contractual relationship, such as in a production contract, the companies share their knowledge with upstream producers to align production according to market needs.

Thus, the creation and utilization of supply chain knowledge, combined with the efforts of the chain members, can influence important outcomes. Therefore, the findings imply that the structure and cooperative efforts of the supply chain should aim to meet a streamlined and shared usage of knowledge in certain areas of production and marketing. A bilateral/relational agreement of knowledge development, sharing and usage will certainly help to facilitate a market-driven supply chain and improve the mechanism for handling risk and uncertainties in agri-food industries. To develop a model of this knowledge asset structure and sharing, the data was investigated further to understand the existing status and difference of knowledge asset management among the supply chain participants of the industry.

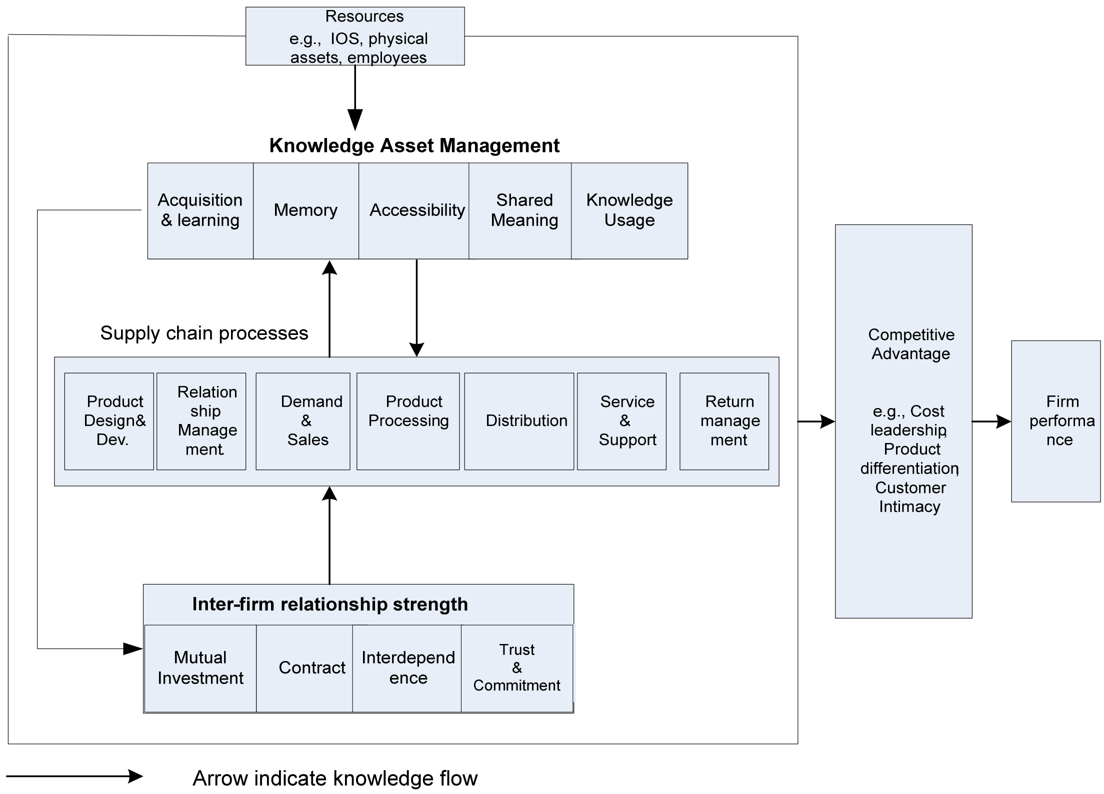
By examining the elements of KAM, the mean of each of the sub-constructs and their items with a t-test, it was found that that the WA beef industry supply chain participants were significantly behind the QLD participants. Significant differences also were found between the producers in each state. WA producers were lagging behind QLD in all the issues of collecting and exploiting knowledge in the supply chain. The results match those of other studies (such as WA Farmers 2009, WY and Associates 2009) that indicate the reluctance of WA producers doing business in a cooperative and innovative environment where learning, sharing and utilizing new knowledge is a key issue. It also reflects the nature of overall WA production-pushed supply chain where profitability is a key issue for some of the upstream participants.

The mean difference across the groups of participants also indicated a significant difference between producers and processors, and between processors and retailers. Processors are significantly ahead in collecting and utilizing market intelligence. Because of the nature of the business and competition in the market, processing companies need to rely heavily on data about beef origin and genetics and market characteristics; also data on the key profit drivers such as supply and demand variation, consumer and market specifications and changes in technologies. While producers and retailers also need to rely on the market and their knowledge of customers, lack of competitiveness and short-term commercial opportunism that exist in the current low cost conventional market transactions result in them not coming forward to form a vertical partnership for an integrated information and knowledge chain. Moreover, comparative analysis according to the firm size showed that smaller firms participate less in knowledge acquisition and utilization activities. This may explain the ability and interest of producers and retailers in KAM as the majority of them are SME as discussed in the demographic section.

Based on the above findings, an overall framework for managing an agri-food supply chain in Australia was developed to align the best principles of value creating strategy of firms seeking competitive advantage. The framework, in Figure 8.2 below, shows that a firm's knowledge assets depend on harnessing five knowledge elements. The unique abilities to apply and utilize these knowledge assets in managing the inter-firm relationship strength and the overall supply chain processes enhance organizational innovations and outcomes.

Although the core basis of the framework is the resource-based view for optimal deployment of existing organizational, physical and human capital resources in supply chain processes, the notion of Hult *et al.* (2006) is accepted that other resources cannot easily be a substitute for knowledge capabilities/resources, as knowledge is a critical input in production and a primary source of value in supply chains. Therefore, the links between KAM and supply chain processes imply a dynamic capability for learning new knowledge from the supply chain process and application of this knowledge for competitive advantage. The link between the knowledge asset and inter-firm relationship strength in the framework implies that a knowledge-driven firm can make better decisions in relation-specific investment, contracting and overall vertical coordination of the supply chain in order to obtain competitive advantage.

Figure 8.2 Management Framework of the Agri-Food Supply Chain



8.2.5 IOS Use in Supply Chain Performance (H6)

Hypothesis H6, as discussed in Section 5.5.5, was split into four sub-hypotheses to explore the impact of IOS use in KAM and relationship strength and in the competitiveness and supply chain performance of the industry.

Hypotheses H6a and H6b stated that the level of IOS use in the supply chain would positively influence the competitiveness and supply chain performance in the beef sector of the Australian agri-food industry. There is much evidence in the literature to suggest that IOS has a positive impact on competitive advantage and supply chain performance (Ali, Kurnia, and Johnston 2007; Li 2002; Mason-Jones and Towil 1997; Mentzer, Flint, and Hult 2001; Premkumar 2000; Radhakrishnan 2005; Saeed, Malhotra and Grover 2005; Sahin and Robinson 2002). The results in Table 7.18 showed that the relationship between IOS and competitiveness (H1a) and IOS and SC performance (H1b) had a path co-efficient of 0.028 (t=0.667) and -0.039 (t=0.668) respectively, which is very low and not significant. Moreover, the result showed that the direction of relationship between IOS and SC performance was negative. Therefore, both hypotheses H1a and H1b were rejected. This is counterintuitive and contrary to what was expected according to the literature.

However, this is not the only study where the uses of IOS in performance and competitiveness have being questioned. Based on empirical evidence, some studies claimed that IOS, especially EDI, does not create a differential benefit to firms (Venkatraman and Zaheer 1995; Powell and Dent-Micallef 1997) and that vertical information sharing may not always increase benefits (Li 2002). It was argued that IOS, by themselves, cannot produce sustained performance advantages unless pre-existing complementary human and business resources are exploited in an integrated way as indicated by the resource based view (RBV). EDI can improve performance only marginally under ordinary conditions, but can produce sustainable advantage in the presence of a strong inter-firm relationship such as trust to produce an embedded mutually reinforcing advantage (Powell and Dent-Micallef 1997).

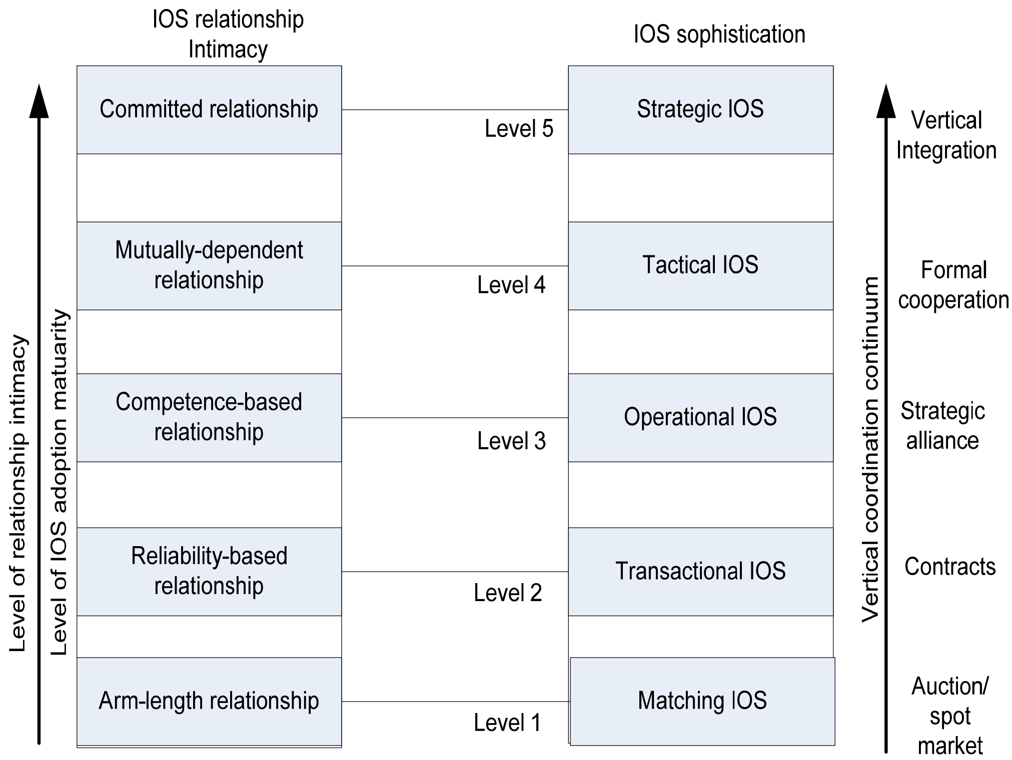
In the light of transaction cost economics (TCE), the widespread use of IOS for business information and communication and the adoption of open standards in these systems, can reduce considerably the coordination and transaction costs and reduce risks in the operation. However, in reality, not all of them are easily implementable because they may not provide the same level of benefit to all supply chain partners (Premkumar 2000). Moreover the amount and types of information that can be shared among the partners is a critical concern because one partner with private information on risk sensitivity often has an incentive to conceal true information; i.e., report incorrect information to the others (Li 2002; Premkumar 2000; Xiao and Yang 2008). Therefore, there are strong disincentives to the volume and diversity of IOS use (the number of distinct documents and transactions completed) for some firms in supply chain relationships, with the result that IOS can be negatively related to performance. IOS and vertical information sharing activities should be studied in terms of gains or losses to the parties who are directly and indirectly involved in this relationship (Li 2002).

Similarly, there is empirical evidence of negative and non-significant relationships between the use of IOS and performance when large firms, such as a supermarket retailer, exercise coercive power or take proactive steps to get the smaller firms (mostly suppliers) to adopt IOS (Hart and Saunders 1998; Premkumar 2000; Son, Narasimhan, and Riggins 2005). This is evidenced in the Australian context especially in the agri-food industry where, traditionally, firms are small in size, managed and owned by one family, and are fiercely independent (WA Farmers, 2009). Market power is dominated by some fifty large firms including two of the biggest supermarket retailers (Short *et al.* 2006). The current survey data showed that more than 85 percent of the respondent firms in the beef industry fall within the definition of a SME. Among them, 80 percent of the WA producers and 35 percent of the QLD producers are not using any IOS system except some form of email communication. Further investigation of the data revealed that, through IOS, the information exchanged is mostly general purchasing information such as payment/invoicing (WA=3.84; QLD=5.03) and purchasing/ordering (WA=3.37; QLD=3.62); while the least exchanged are critical and private information such as production (WA=2.55; QLD=2.89) and quality control (WA=2.79; QLD=3.18). When classified according to firm size, a significant mean difference was found between the groups of firms ($p<0.000$) with bigger firms using more electronic systems/IOS. In addition to the survey findings, the field study showed that in the absence of any visual incentives, initial investment and compatibility of using IOS such as a compatible system, system upgrading and privacy agreements are common problems resulting in reduced use of IOS among the smaller firms in the agri-food industry. Therefore, the evidence from the literature and from this research is consistent and, as discussed above, may contribute to the non-significant and negative relationship of IOS with supply chain performance in the Australian agri-food industry.

However, the structural model indicated acceptance of two other hypothesized effects of IOS in H6c (β 0.411, 9.956 $p<0.000$) and H6d (β 0.111, $t=2.459$, $p<0.05$); they provide strong evidence of a direct IOS role in enhancing the level of KAM and inter-firm relationship strength and, thus, an indirect role in supply chain performance. The findings are consistent with those of previous studies (Powell and Dent-Micallef 1997; Borman 2006; Alavi and Leidner 2001) which found that IOS enhances access to sources of knowledge, creates greater breadth and depth of knowledge flows, and develops other organizational competencies. IOS enhances knowledge transfer and sharing and opens up a wide range of business opportunities. The result is consistent also with the literature (Ali, Kurnia and Johnston 2007; Chatfield and Yetton 2000, Premkumar 2000; Powell and Dent-Micallef 1997; Son, Narasimhan, and Riggins 2005) that that identified the level of IOS use as a determinant of relationship strength – the trust, commitment, and relation-specific investment in the supply chain. In these studies it was argued that IOS can be used to develop more cooperative and long-lasting relationships in the supply chain.

The implication from the overall findings, therefore, is that IOS use can produce sustainable advantage in supply chains when used as complementary business resources in the presence of strong inter-firm relationships and knowledge sharing attitudes. For improved information accuracy and improved ordering, processing and distribution of goods in the supply chain, the level and adoption of IOS should be matched with the existing intimacy of the relationship and in the context of the supply chain. Therefore, based on the study of Ali, Kurnia and Johnston, (2007) and on the notion of TCE and vertical coordination continuum stated earlier, a five-level IOS adoption model can be proposed for the Australian agri-food industry. This is illustrated in Figure 8.3.

Figure 8.3 IOS Adoption Strategy based on Relationship Intimacy/Vertical Coordination



Source: Adapted from Ali, Kurnia and Johnston (2007), Peterson and Wysocki (1997).

The figure shows that at Level 1 - a matching IOS should be used in an arms-length relationship when organizations have a lack of trust, have alternative sources of business and are not interested in establishing any long term relationship. At this stage, IOS can be used only to match business transactions between buyers and sellers based on price, quality or some other market information using simple calculations. At Level 2 – a transactional IOS can be used when parties feel confident enough to conduct business repeatedly based on bilateral forms of contracts and dependence. The functions can automate the process of exchanging documents such as invoices, purchase orders, sales and so on. At Level 3 – when trust and obligation are becoming high, routine structured communication can be changed to operational IOS, a higher level of integration for information exchange in a competence-based relationship, alliances or partnerships. At this stage, a long-term focus can be conducted to streamline and coordinate routine transactions such as logistics and distribution and additional services such as training in the use of technology. At Level 4 – common norms and corporate relationships can be developed for the tactical use of IOS within a mutually dependent relationship. This level of IOS use can be triggered by asset-specific investments, sharing of critical information, and synchronization of production, sales and distribution. At the final Level 5 - strategic IOS with a fully integrated system can be used for a fully trusted and committed relationship with multilateral power structure. This relationship is compared to the level of full vertical integration.

8.2.6 Relationship Strength in Supply Chain Performance (H7)

The factors involved in developing competent inter-firm relationships and their affect on supply chain performance and competitiveness were also a focus of this study. Like vertical coordination in hypothesis H3, the inter-firm relationship construct was developed as a higher-order construct using five sub-constructs in a formative dimension (discussed in Chapter 5, Section 5.4.1.1). The beta weight, as shown in Table 7.18, demonstrated that commitment had the highest contribution in formulating relationship strength, followed by mutual investment, trust and interdependence. Results indicated that the capability and strength of inter-firm relationships are deeply embedded into the pattern of commitments in supply chain transactions such as mutual investment that depends on the level of capital, infrastructure and people investment; trust that depends on the level of honesty and honour accorded to each other; and interdependence that relies on the switching capability and level of business disruption when a relationship is ended. The theoretical lens from TCE and RBV and the result of the field study provided a strategy framework in developing relationship strength by examining these key issues of economic exchange in a supply chain. The literature in the agri-food industry domain shows considerable evidence that durable relationships between supply chain partners develop from the level of trust, commitment, and interdependence and mutual investment; these are strategic weapons to by-pass the cost of traditional market transactions for greater cost savings and profitability (see Clare, Reid and Shadbolt 2005; Duffy 2008; Hobbs and Young 2000; King *et al.* 2010; Meloni and Benton 2000; O'Keeffe 1998; Petersen and Wysocki 1997; Szabo and Bardos 2006; Terawatanavong, Whitwell and Widing 2007).

The test of the structural model also provides empirical evidence that inter-firm relationship strength can strongly influence competitiveness (H7a supported at β 0.145, t=2.649, $p<0.05$) and supply chain performance (H7b supported at β 0.175, t=2.777, $p<0.005$) in the beef sector of the Australian agri-food industry. This supports the insight of RBV/TCE and is consistent with literature describing a strong inter-firm relationship as a value-creating strategic/economic resource that can contribute to firm performance and competitiveness. Relationship strength based on joint venture, interdependence, commitment and trust enhances business transactions, minimizes cost structures, and improves productivity and profitability of firms (King *et al.* 2010; Terawatanavong, Whitwell and Widing 2007). Again, this is consistent with the findings that a long-term relationship emerges when one partner depends on another in a unique way and exhibits strong trust which, ultimately, is able to reduce costs over time at a rate comparable to sales growth (Clare, Reid and Shadbolt 2005; Kalwani and Narayandas 1995; Maloni and Benton 2000). For example, a committed and trusted long-term relationship can avoid the costs of monitoring the true quality of beef, can reduce the lead-time in sourcing and can ensure greater consistency of meeting market specifications. The BeefNet program of Meat and Livestock, Australia in 2002 found that producers who participated in a stable supply chain relationship experienced greater price stability and profitability because of the increased product feedback/information sharing, understanding of beef market and the enhanced capability of farm management to meet market specifications. But opportunistic behaviour and lack of commitment of the members caused the alliance to fail eventually (WY and Associates 2009).

Findings from the current exploratory field study also provided evidence that the dominance of open markets and arms-length relationships are putting the Australian beef industry in an uncompetitive position; they are separating the upstream producers from the rest of the beef chain and causing barriers to understanding the supply chain value-added cost, to understanding the business of downstream partners and to developing trusted relationships in the supply chain. However, the field study found evidence that producers' interest in developing a long-term relationship with their supply chain partners is increasing as it can reduce uncertainty when selling their beef products. For the processors and retailers, long-term dealing, direct communications and information sharing with suppliers can reduce the cost of repetitive sourcing, contracting, and monitoring a consistent supply and quality of beef.

Further evidence about the specific components of supply chain relationships was obtained from the survey data by looking into the mean (on a seven point scale) of the relationship items. All the issues of mutual investment such as investment of people and time, capital and specific infrastructure in the beef supply chain were found to be very low as indicated by means between 2.00 and 3.00. In terms of interdependence, retailers have the highest switching capacity both in WA and QLD. They maintain multiple sources of fresh beef from wholesalers, the processors and from the open markets. Although, processors expressed high concern (WA=4.30; QLD=3.62) that their partner would face severe business disruption if the relationship was ended, producers and retailers did not think the same way. However, on the positive side, indicated by a mean of around 5.0, participants have a moderate level of business commitment and trust in the buyer-seller relationships. It was found that 10-15 percent of the participants strongly disagreed about the existence of trust, commitment and a good relationship climate in the supply chain. WA farmers doubt the possibility of having a good mutual understanding of business with their supply chain partners and believe that their buyers would deliberately take a course of action that affects them negatively. When firms were compared according to their size, it was not surprising to see that small firms have less trust in their supply chain partners; they believed that their partners would not face any business disruption if the relationship was ended. The sharing of business risks, the burdens and the benefit of transactions were found to be very low among all the participants in WA (μ= 3.37) and QLD (μ= 3.41).

However, the empirical evidence of the impact of relationship strength and a deeper understanding of the elements of the relational exchanges from the survey have practical implications about how the basis of this relationship can be developed in the Australian agri-food industry. Studies have viewed relationship strength as a dynamic process, which can be evolved through a lifecycle consisting of five phases: awareness, exploration, build-up, maturity and decline/deterioration (Dwyer, Schurr and Oh 1987, Jap and Ganesan 2000; Terawatanavong, Whitwell and Widing 2007).

Each of these relationship phases has different levels of coordination and trust, commitment and interdependence, as shown in Figure 8.4 which summarizes strengths in four phases.

Figure 8.4 The Phases of Building Relationship Strength

		Relationship Phases			
Relationship Strength		**Awareness and exploration**	**Buildup**	**Maturity**	**Decline/deterioration**
	Trust				
	Commitment				
	Interdependence				
	Cooperative norms (such as mutual investments)				
	Conflict				
Coordination Type		Limited coordination	Highly coordinated	Partnership	

Source: Adapted from Wilson (1995); Terawatanavong, Whitwell, and Widing (2007);
Duffy (2008).

In the awareness phase, a feasible exchange partner is identified based on the reputation and available alternatives in the market. Once the communication and trial exchanges meet the expectation or benchmark, the exchange partners may enter into the exploration phase to continue the transaction and build up trust. This phase can demonstrate the degree of performance, interdependence and trust by verifying the level of commitment, cooperative norms and exercise of power in the bargaining and negotiation processes. It is argued, usually, that interdependence is difficult to achieve because of the size imbalance between a producer and processor, or producer and supermarket retailer (O'Keeffe 1998). When a market, as in Australia, is dominated by large buyers, the independent small producer is at a disadvantage.

However, small producers can achieve some degree of bargaining power and respect from their powerful buyers by differentiating and creating economies of scale in production, by knowing the niche market, and by creating *alliances* both horizontally (among producers) and vertically (among producers, breeders, feedlot operators, packers etc.) with *partners* with similar goals. For example, cow-calf producers' alliances can help in meeting market specifications, animal health and management objectives by grouping together animals with like-type, finish and cut-ability, which also allow equal sharing of the potential profits through retained ownership. When involved in the mainstream supply chain, a degree of mutual adaptation such as product or process adaptation is needed for the alliance to achieve interdependence. This adaptation to suit the buyer's market can indicate also the level of commitment to that buyer. This is important and can indicate the peak of relational bonding (Terawatanavong, Whitwell and Widing 2007).

Thus, based on the value creation and history of transactions, the inter-firm relationship can enter into the third, build-up phase. This involves making decisions to augment the relationship norms (such as information exchange) and interdependence, and decisions to allow greater access to capital, expertise and information resources. The sense of satisfaction, commitment and intensity of trust assists both parties to countenance a long-term future.

Finally, accumulated trust and commitment, experiences and alignment of goals can turn the relationship to a matured phase, thereby enhancing mutually agreed business norms, relation-specific investments and the deepening of interdependence. This phase also should involve risk management and sharing of rewards, emphasizing the exploitation of the core capabilities of the parties. However, in situations of increased levels of disagreements, changes in either internal or external circumstances may force the partners to withdraw gradually from the relationship.

8.2.7 Price Uncertainty and Supply Chain Performance (H8)

It was hypothesized that price uncertainty in the beef industry has a negative influence on the strength of inter-firm relationships (H8a) and on supply chain performance (H8b). The findings from the field study were used principally to infer these negative relationships as participants emphasised that a successful relationship cannot be built without sharing the fluctuations of the market; the associated risks and price volatility. The study also provided evidence that, without a cohesive and innovative supply chain, price certainty and profitability of the participants is difficult to achieve.

The structural model test showed that the first relationship in hypothesis H8a was not supported. The low path coefficient (price uncertainty → relationship strength, β - 0.025, t= 0.566) indicated that, although a negative relationship may exist between price uncertainty and inter-firm relationship strength, it was not significant enough to support the hypothesis. Given this lack of support, bivariate correlations were conducted between price uncertainty and the dimensions of relationship strength to test whether the isolated pairs of constructs also exhibited the same outcome (Quaddus and Achjari 2005, Jackson 2008). The analysis revealed that while price uncertainty has a possible negative correlation with all five dimensions of relationship strength, it had significant negative correlations with three of the dimensions: trust, commitment and contract choice ($p < 0.01$). This makes intuitive sense, because if the supply chain transaction is dictated by the inequality of sharing highs and lows of the market where price uncertainty is a common element, it can negatively influence trust, commitment and a long-term relationship. For example, a buyer could wait for a sale to buy in bulk instead of providing advance information of their requirements (Premkumar 2000).

However, the results provide support for the second relationship in H8b that price uncertainty has a strong negative influence (β - 0.178, t= 3.395) on supply chain performance. The finding is consistent with the field study and with the literature that collaboration, sharing of demand information and synchronized production across the supply chain can eliminate some forms of price uncertainty and are essential for cost efficiency and profitability in the supply chain (Hobbs 1997; lee 2002; Sandmo 1971; Ho, Chi and Tai 2005). Absence of this synchronized supply chain can inflate downstream price and provide unequal margins in the upstream (Tsay and Agrawal 2000). The findings are in parallel with other findings on performance issues as discussed in the earlier sections of this study; they suggest a greater effort should be made by WA beef industry players to integrate the upstream producers in a streamlined supply chain in order to meet the issues of productivity and profitability.

In this study further investigation was made of the types of uncertainties that lead to unstable prices in the beef industry; the purpose was to explore whether the intensity of uncertainty was relevant to any particular group of supply chain participants. The results in Table 8.3 show that all the issues, in terms of total mean, except uncertainty in the demand for beef, are highly concerning to the participants with a mean above 5.0 (in a 7-point scale anchored 'strong disagree' to 'strongly agree').

Table 8.3 Uncertainties in the Beef Supply Chain

		Producers WA=83, QLD=49		Processors WA=32, QLD=65		Retailers WA=48, Qld=34			
Issues/item	States	Mean	Sig. (2-tailed)	Mean	Sig. (2-tailed)	Mean	Sig. (2-tailed)	**Total Mean**	Sig. (2-tailed)
Over time and season, the supply of beef-cattle or meat fluctuates widely	WA	5.45	.583	5.09	.610	4.38	.612	5.08	.839
	QLD	5.61	.577	4.86	.605	4.62	.612	5.04	.839
There is significant uncertainty in the demand for beef-cattle/meat products	WA	5.28	.018	3.64	.429	3.65	.125	4.45	.018
	QLD	4.55	.021	3.31	.426	4.29	.131	3.93	.018
We need to inspect beef-cattle or meat closely to ensure quality and grade	WA	5.89	.641	5.27	.012	5.65	.001	5.65	.005
	QLD	5.78	.660	6.15	.028	6.71	.000	6.13	.005
We believe that we are not getting enough margin from our sales	WA	6.57	.021	5.42	.687	5.48	.481	5.99	.283
	QLD	6.14	.028	5.58	.690	5.74	.471	5.81	.283
Price fluctuation for our products is a real management problem	WA	5.76	.880	5.18	.246	4.48	.937	5.26	.162
	QLD	5.71	.870	4.68	.242	4.44	.938	4.95	.162
We feel that the carcass specification (weight, fat, conformation) strongly influences our product price.	WA	5.30	.482	5.21	.219	5.54	.684	5.33	.501
	QLD	5.51	.456	4.66	.182	5.71	.686	5.19	.503

The difference between WA and QLD is also prominent as the data shows QLD has less uncertainty in demand but high concern to ensure quality and grade. This is perhaps because of the vibrant export market and more forward and backward integration among supply chain players. Among the groups, WA producers and processors showed significant concern about supply and demand uncertainty and not getting large enough margins from the sales. WA Farmers (2009) reported that the inconsistency of the supply of product, labour resources and the lack of profitability caused a rapid decline of the processors and the ability of feed-lotters. As a result, effectively there are only four major processors of both sheep and cattle in WA. QLD producers and processors, compared to WA, have reduced significantly the uncertainty in demand and are well ahead in ensuring quality and grade of beef. When comparing the groups of participants according to the size of firms, it was interesting not to find any significant difference between the groups, although smaller firms showed more concern for not getting the required margin.

Thus, the overall result indicates that price uncertainty in the Australian beef industry is associated with the structures of the market, nature of production, seasonal variations as well as the carcass specifications that affect supply and demand of beef and can influence the income of upstream producers in conventional marketing systems. The downstream processors and retailers also can be affected by inconsistent supply and quality requirements unless they maintain a good contract with the producers whereby the profitability of both parties is ensured. Therefore, any policy intended to drive down the uncertainties should be geared around the improvement of inter-firm relationship strength, vertical coordination, and improved information and knowledge flow among the supply chain participants. This study assumes that improved collaboration between producer, processor and retailer can improve a decision on the volume of production prior to a sales date with a mutually agreed price mechanism. Also, producers and processors can eliminate some forms of price uncertainty in a multi-product firm by output diversification and meeting different market conditions.

8.2.8 Negotiation Power in Supply Chain Performance (H9)

In line with a wealth of research that examines different power influences in marketing channels, the researcher investigated the positive impact of negotiation power in the supply chain of the beef industry within the Australian agri-food industry. The hypothesis was split into two sub-hypotheses to examine the impact of negotiation power on inter-firm relationship strength (H9a) and on supply chain performance (H9b). The model test found strong support for both hypotheses in a positive direction where H9a had a path coefficient of β 0.217 ($t=4.487$, $p<0.000$) and H9b had β 0.197 ($t=3.517$; $p<0.000$). Thus, result supports the propositions that negotiation power in the supply chain positively influences inter-firm relationship strength and supply chain performance. The result also supports the field study findings that to play a positive consequential role in the formation and maintenance of supply chain relationships and to maintain profitable business operations, all players in the supply chain should have some degree of negotiating power. The result is consistent with the literature that, without bargaining or market power, it is difficult to develop a lean partnership with associated trust, commitment and interdependence where large firms extract as much value as possible from the supply chain transaction (Szabo and Bardos 2005; Sodano 2006; Revell and Liu 2007). It also supports the argument that power is associated with functional coordination that comes only through the emergence of a chain driver to strengthen the relationship and to increase performance in the supply chain (Daviron and Gibbon 2002). The result implies that all supply chain players in the agri-food industry must develop a profitable operation by adopting a stronger business and commercial model. Before commenting further, it is imperative to look at the survey data once again to understand the power structure of the industry.

In this study, an attempt was made to measure the bargaining or negotiation power among industry participants using three items on a scale of 1-7, anchored as 'strongly disagree' to 'strongly agree'. Table 8.4 below shows that producers have much less ability (WA=1.59; QLD 2.22) to negotiate prices in the supply chain than do processors (WA=3.78; QLD 3.55) and retailers (WA=3.27; QLD 3.94). Producers also showed a higher concern that the price offered by buyers is a great problem (WA=5.93; QLD 6.08) and that they enjoy fewer economic benefits in addition to price (such as suitable place, cost and time of delivery) from the relationships (WA=2.77; QLD 3.41).

Table 8.4 Negotiation Power in the Beef Supply Chain

Items/issues	States	Producers WA = 83, QLD = 49		Processors WA = 32, QLD = 65		Retailer/ Wholesaler WA = 48 and QLD 34		Total Mean	Sig.
		Mean	Sig.	Mean	Sig.	Mean	Sig.		
We have enough influence on supply chain to negotiate price	WA	1.59	.008	3.55	.588	3.27	.126	2.52	.002
	QLD	2.22	.018	3.78	.608	3.94	.130	3.19	.002
Having to take whatever price offered by the buyers is a great problem	WA	5.93	.595	3.84	.396	N/A	.563	5.03	.679
	QLD	6.08	.575	4.23	.386	N/A	.558	4.93	.679
We enjoy other economic benefits, in addition to price, from our transaction relationship (e.g. determining place and time of delivery)	WA	2.77	.040	4.72	.102	3.98	.867	3.54	.242
	QLD	3.41	.048	4.05	.082	4.06	.869	3.80	.243

Significant differences are indicated by the shading.

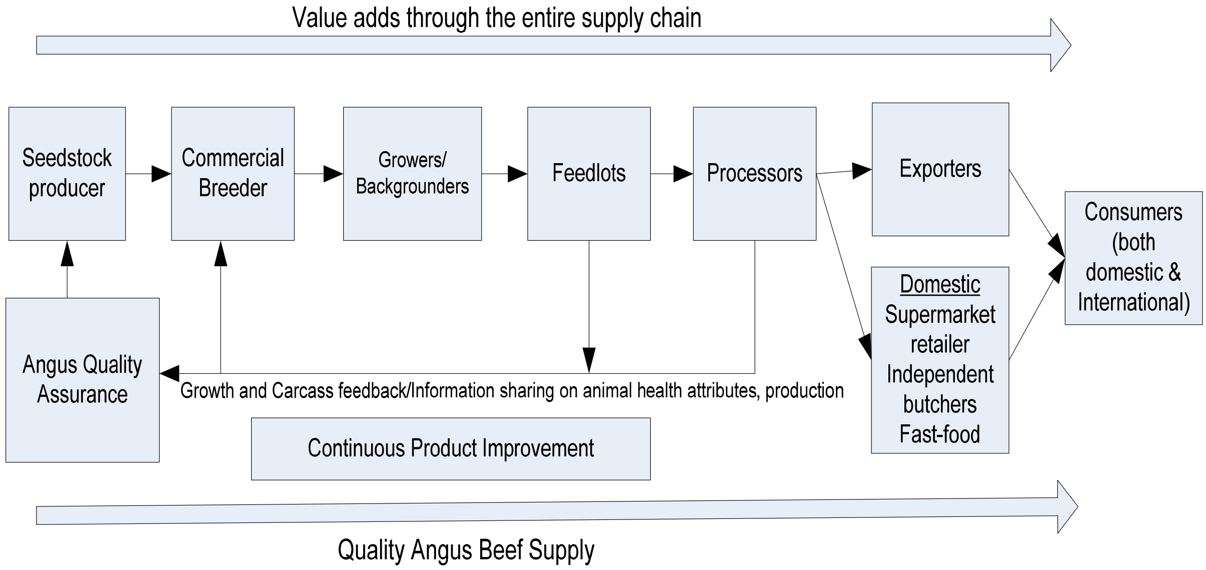
A second question was asked in a different way to the retailers/wholesalers who, compared to their downstream partners, typically have a buyer role in supply chain transactions. They were asked to rate the problem of determining price with their supplier. The mean score (WA 4.42; QLD 4.67) showed it was not great a problem for the retailers/wholesalers. Thus the total result indicates a significant power imbalance between producers and the other members of the supply chain. When the mean scores were classified according to the size of firms and compared in a t-test, it was not surprising to find that the power of a firm significantly increases as its size increases.

The results reflect the true nature of the beef industry power structures in WA and QLD; and, generally, overall in Australia. The retailing power in the Australian domestic market is dominated by the top two supermarket retailers – Woolworths and Coles – both at the national and state levels. Together they maintain more than a 50 percent share of the market, which rationally gives them the ability to dominate market prices (WA Farmers 2009)**.** On the other hand, the vibrant export market for

Australian beef has helped some processors, such as the QLD processors to dominate the processing sector and reduce some of the market power of supermarket retailers. Overall, the Australian beef market has a high concentration of market power at the processor and retailer levels and is buyer dominant, while only a small difference exists between the two as evidenced by the results. In WA, the beef industry has a very small proportion of export processing capacity and only a three percent share of Australia's total beef exports; therefore the focus on the domestic market (almost 64 percent) creates dependence on the large supermarket retailers for the commercial viability of the processors (WY and Associates 2009). This is mainly to align the demand and supply of particular cuts of meat and is related to the issue of carcass balance.

The relative power of farmers/producers in the Australian agri-food industry typically depends upon supply scarcity. Unless they are in a long-term interdependent relationship (such as some integrated QLD producers that the results show as having more power than WA farmers), farmers tend to become price takers when there is sufficient supply. In this kind of buyer-dominated market, Cox and Chickland (2008) suggested that operational adoption of a lean supply chain is unlikely to be successful. Instead, it is feasible to develop lean partnerships between retailers and major processors or the processor and farmers (as depicted in Figure 8.5) where farmers and processors can get higher net returns by greater compliance with carcass specifications, alignment with market needs and by guaranteed supply. As discussed in the vertical coordination and relationship strength sections, farmers can increase their bargaining power by creating horizontal cooperatives or vertical coordination and by differentiating and creating economies of scale in their production, such as producing cattle with a shorter feeding period and less waste fat. For example, a horizontal alliance such as a marketing cooperative could be formed by producers to package and merchandize cattle consistently in specific groups and in large volumes. Such alliances often can negotiate improved business terms. Another example is Angus cattle which now receive the highest market premiums for consistency in meeting all types of demand both in domestic and export markets. A vertical alliance among commercial breeders, growers, backgrounders, feedlots and processors could easily organize production and breeding of Angus cattle as a successful niche market player while, at the same time, maintaining the flexibility of farming to meet alternate options to meet any uncertainty. Figure 8.5 provides a model of this vertical production and marketing strategy between producers and processors**.**

Figure 8.5 A Model of Gaining Market Power through Producers-Processors Coordination



Source: Adapted from Angus Australia, 2010 (www.angusaustralia.com.au)

Thus, targeting to serve some specific markets in a channel marketing approach with commitment and willingness to cooperate with each other for added labour, resources and knowledge in producing high quality cattle, producers can gain power as a marketer rather than as a seller. Similar to this approach are other alternative marketing strategies such as lean, organic, natural, pasture-finished (or grass-fed or grass-finished) or other selling points such as no antibiotics, locally raised, family farm and humanely produced. These strategies can turn price-takers into price-makers.

8.2.9 Competitiveness through Supply Chain Performance (H10)

The final hypothesis to be tested involved measuring the impact supply chain performance has on competitiveness in the industry. Recent literature has been consistent in claiming that competitive advantage actually can be achieved by leveraging the management of the supply chain (Fearne 2008; Ketchen and Hult

2007; Lee 2002). The field study findings also showed that Australian agri-food industries are developing their competitive strategies stemming from the performance of the supply chain. This belief is also strongly reflected by the results of the present research when the structural model supports the proposition that supply chain performance has a significant positive influence in achieving competitiveness of the industry ($\beta = 0.412$; $t = 10.273$; $p < 0.000$). Both dimensions of customer-facing (measured firm responsiveness and reliability in fulfilling orders, deliveries and related queries on time) and internal-facing (measured internal improvement of productivity, cost efficiency and return from the assets) were found significantly related to supply chain performance. As PLS calculates all of the indirect effects, in addition to the direct effect of establishing the relative importance of antecedent constructs, the total effect of supply chain performance on competitiveness reveals that competitive advantage lies in system efficiencies and performance of the supply chain. The result has implications in that the ability to learn, create and exploit new knowledge and the ability to create a shared cooperative environment with a strong relationship, governance structure and power bases among the chain members can enhance supply chain performance and, thereby, the competitive advantage of the industry. The shared, cooperative environment means sharing of demand information, synchronized planning of production and highly effective logistic infrastructure that can result in cost efficiency and productivity improvement and lead to competitiveness in the industry (Lee 2002).

Therefore, any policy intervention from the stakeholders to improve competitiveness in the industry should be geared along the lines of improving the supply chain and its antecedent factors such as vertical coordination and integration of the industry; strong inter-firm relationships and knowledge sharing; and reducing price uncertainty and power imbalance in the industry. For example, an integrated beef supply chain from upstream producers to downstream processors and retailers can offer better marketing opportunities and prices for all the parties involved. It can establish continuous supply and choices for processors/exporters to allow expansion of markets, scale of operations, and competition (DAFWA 2010). Collective organizations and infrastructures of knowledge and services in the supply chain such as farmers' markets, web directories, and new technologies for improving refrigeration, transportation, and communication capacities also can enhance the competitiveness of the industry. It has been argued in studies that it is important to be in a part of the supply chain to achieve this enhanced competitiveness with an intention to compete against other supply chains rather than as a single firm competing against other individual firms (Christopher 1998; VanderVorst 2002). Table 8.5 provides some suggestions regarding the key roles and guidelines for supply chain members and other stakeholders such as government, to create competitiveness in the beef industry.

Table 8.5 The Role of Supply Chain Stakeholders for Creating Competitiveness

Industry stakeholders	Role	Attitude	Knowledge
Primary producer	▪ Moving from product to market orientation ▪ Direct marketing/ alternative marketing strategy to become price-makers not price-takers ▪ From independence to value-based interdependent producer ▪ Changing from daily to long-term planning	▪ Moving from market transaction to long-term partnership. ▪ Acquiring market intelligence from the partnership. ▪ Restructuring farm scale, size, and focusing the profitability/economies of scale. ▪ Developing new ideas in horizontal (producers cooperatives) or vertical cooperation (producer-processors), contract forming, and uncertainties ▪ Emphasizing customers and consumers ▪ Future vision and goal	▪ Alternative beef marketing operations such as lean, organic, natural, pasture-finished ▪ Details of supply chain value-added costs and margins. ▪ Labour, resource, and product management ▪ Marketing management skills ▪ Understanding/application of new technologies for improving animal health and genetic attributes.
Processing Industry	▪ Organizing instead of following the chain ▪ Branding and adding value	▪ Leading the industry for supply chain cluster/market development networks ▪ Export focus ▪ Moving from short term/market transaction to long-term partnership ▪ Vertical cooperation with producer and/or retailer for consistent supply/ demand. ▪ Enhance satisfaction and understanding of the suppliers and customers ▪ Branded niche market product ▪ Developing own process oriented business operations	▪ Development of direct or intermediate supply chains ▪ Export marketing scale and efforts ▪ Tracing total cost of transactions in the supply chain ▪ Ensuring efficient consumer response ▪ Product differentiation ▪ Understanding specific market demand and developing value-added products for that market

Retailer/ Exporter/ Trader	▪ Concept and formula leader. Organizer of finance and logistics ▪ Translating consumer wishes ▪ Moving from information/knowledge protection to information/knowledge sharing.	▪ Integrated supply chain and value interdependencies. ▪ Prioritizing grower-base supply chain ▪ Balancing cooperation and power ▪ Moving from short term/market transaction to long-term partnership. ▪ Strategic alliance and co-investment ▪ Moving from high margin to continuity and commercial stability. ▪ Export culture and export supply competition	▪ Investing in new technologies, production systems and logistics. ▪ Tracking and tracing the whereabouts of products ▪ Developing chain knowledge and chain quality ▪ Developing market and brand name ▪ Understanding specific market demand ▪ Developing contracting procedure, price setting, and business strategy
Government	▪ Effective catalyst for creating and supporting competitive environment/commercial viability of the industry. ▪ Understanding the cost and profit drivers of the industry.	▪ International trade development support ▪ Land, water, port, rail, and other infrastructure support. ▪ De-politicization of industry decision making	▪ Strategic development priorities. ▪ Export culture and market access ▪ Regulatory complexity and compliance cost ▪ Comparative land and water availability cost ▪ Skilled human resource ▪ Bio-security disease status ▪ R&D efforts

Source: Adapted from Newton (2000); WY and Associates (2009); current research findings.

8.3 Summary

Given the findings of the research outlined in Chapter 7, the discussion and interpretation of the results in this chapter has yielded substantial implications for the stakeholders in beef industry supply chains; implications equally applicable for the overall agri-food industry supply chains in Australia. Chapter 7 demonstrated that knowledge asset management is the strongest predictor of supply chain performance, followed by negotiation power, price uncertainty, inter-firm relationship strength and environmental management. Results also demonstrated that supply chain performance strongly influences competitiveness in the industry as a whole.

Thus, the results of the study support both the direction of theoretical underpinning from RBV/KBV and TCE in the agri-food industry that knowledge asset management, inter-organizational system and relationship structure can be considered as value creating strategic/economic resources and can contribute to firm performance and competitiveness. Therefore, the implication is that the structure and cooperative efforts within the supply chain should aim to meet a synchronized production, information and knowledge flow for a market driven supply chain; they can ensure a cohesive way of handling the risks and uncertainties and can ensure cost efficiency and profitability for of all the parties involved in the supply chain. In addition, any policy intervention to improve the competitiveness of the industry should be geared along the lines of improving the supply chain and its antecedent factors found in this study.

Where applicable, further investigation in this chapter was made into the components of the factors by conducting independent sample t-tests between the states and groups of supply chain participants. This revealed that, in some cases, WA supply chain performance was lower than that in QLD as a result of conventional market and relationship structures, power and profitability structures, and the declining strength in relationships especially in the areas of mutual investment, interdependence and trust. Compared to WA, QLD has an improved market structure based on contractual and coordinated relationships such as asset-specific investment and sharing of supply chain information. The study identified a buyer-dominant market where the power is concentrated in processors and retailers and in the large retail firms. Producers' power is dependent on scarcity of supply; as a group they reported less economic benefit and a lower price margin from the supply chain. Significant differences also were found in the use of electronic systems and in harnessing and utilizing the knowledge asset.

The overall results indicate that success requires a shift from a production driven supply chain to a market driven chain and closer ties between the upstream and downstream partners to achieve greater communication and commitment. For the operational adoption of a lean supply chain between producer and processors or processors and retailers, key success factors in the beef industry are transparent interdependent relationships with a strong consolidation/integration of business activities, strong communication and knowledge flow, and a greater compliance with carcass specifications in the supply chain. For example, producers can improve their negotiation power and profitability by horizontal cooperation (such as with the breeders, backgrounders and feed-lotters) or by forming strategic relationships with the processors for a greater supply consistency and compliance with the carcass specifications of both domestic and export markets. They can also add value to their beef by differentiating the product from the supermarket line and by producing beef for niche markets. By aiming to serve some specific markets by means of a channel marketing approach with commitment and willingness to cooperate with each other for added labour, resources and knowledge in producing high quality beef, producers can gain power as a marketer not a seller. The results demonstrated evidence that QLD producers, who are aligning production with specific market needs, can improve their profitability.

Chapter 9

Conclusion and Future Directions

9.1 Summary of the Research

Motivated by the problems of cost competitiveness, profitability and market development issues in the Australian agri-food industry, the current study was designed to addresses research questions as to how the levels of inter-firm relationships, knowledge asset management and inter-organizational systems impact on the performance of the supply chain and differentiate performance in the industry. It has been argued that supply chain performance can be a strategic development option for the profitability, sustainability and competitiveness of the industry. Supply chains in the Australian agri-food industry have been based mainly on market arrangements with operation production pushed and often adversarial, with members having profitability problems and, often, lacking innovative actions for developing products and the business based on insights from their customers. The study, therefore, determined that competitive performance of the industry depends on improving cost efficiency across the whole of supply chain, including the underlying value chain which can be improved by developing information and knowledge flows, inter-firm relationships and the factors related to the coordination structures of the industry.

With the main objective being to investigate the extent to which the inter-organization relationships, coordination structures and systems, and knowledge asset management are the source of supply chain performance in the Australian agri-food industry, five specific objectives were pursued as outlined in Chapter 1. A thorough literature review on various theoretical and industrial aspects of the research problem helped to develop a preliminary research model and address the objectives outlined in Chapter 2. The constructs of the research model were developed principally using the concepts from resource based view (RBV), knowledge based view (KBV), and transaction cost economics (TCE) in agribusiness.

Using a pragmatist approach, the study was undertaken using a mixed methods research that involved a first phase of qualitative data collection to enhance the theoretical model and develop survey instruments, followed by a second phase of quantitative data collection and analysis to test the research hypotheses.

The main purpose of the qualitative first phase (exploratory phase based on in-depth interviews with eight agri-food firms, as discussed in Chapter 4) was to explore the research questions in real world conditions and fulfil the research objectives by exploring the impact of existing formal and informal transaction relationships and their governance structures, existing practices of knowledge asset management, and the use of inter-organizational systems in the supply chains of agri-food industry. The content analysis of the transcripts of interviews with eight agri-food firms from this phase helped to identify important factors and variables related to the performance of the supply chain which, later, were aligned with the literature and incorporated to enhance the initial theoretical research model to develop a final research model and propose hypothesized relationships. Based on the findings from this phase, the constructs *vertical coordination, transaction climate, negotiation power, price uncertainty* and *environmental management practices* were found to have important antecedent roles in *inter-firm relationship strength, knowledge asset management, IOS use* and in *supply chain performance*. Therefore, they were added to the final model to assess their direct and indirect roles. Qualitative findings also indicated that supply chain performance is a source of competitiveness for the industry and, thus, the construct *competitiveness* was included in the new model for further investigation of the link with *supply chain performance*. Justifications for the new model were made by revisiting the literature within the frameworks of TCE, RBV, and KBV.

The second confirmatory phase was based on structural equation modeling, as discussed in Chapter 7 of the research; it involved finalizing the research model that used 22 hypotheses targeting factors of supply chain performance in the specific agri-food industry, viz., the Australian beef industry. A questionnaire was developed and pre-tested, followed by a pilot study of 68 participants. Finally, data were collected through a telephone survey of 315 firms including input suppliers, producers, processors and retailers in the beef industries of Western Australia and

Queensland. Descriptive data from the survey were analyzed using SPSS17 while the hypotheses were tested by using partial least square (PLS) based structural equation modeling (SEM).

Assessment of the research model demonstrated that 18 of the 22 hypotheses, made up of 11 primary factors and 15 sub-factors, were supported. Thus, the results indicated that respondents considered a majority of the factors to be important in supply chain performance and the competitiveness of the industry. Among the predictive factors, *knowledge asset management* was found to be the strongest predictor of supply chain performance, followed by negotiation power, price uncertainty, inter-firm relationship strength and environmental management practices. Results showed that the factors competition intensity, vertical coordination and transaction climate were significant antecedents of knowledge asset management, IOS use and inter-firm relationship strength in the Australian context. The study also examined the important elements of vertical coordination, knowledge asset management, inter-firm relationship strength and supply chain performance by modelling them in a higher-order multi-dimensional construct. The results established that vertical coordination significantly depends on the level of inter-firm coordination and the formalization of transactions, while relationship strength in the supply chain depends on the level of commitment, mutual investments, trust and interdependence of the firms respectively. In knowledge asset management all dimensions of knowledge acquisition and learning, accessibility, memory, shared meaning and knowledge usage were significant while for measuring supply chain performance both the internal-facing and customer-facing performance dimensions were significant. Finally, statistical evidence proved that the supply chain is a source of competitiveness in the industry. As PLS calculated all of the indirect effects in addition to the direct effects to establish the relative importance of antecedents constructs, the total output of the 'SC performance' affect on 'competitiveness' revealed that competitive advantage lies in system efficiencies and the performance of the supply chain. A detailed discussion and implications of the results were given in Chapter 8.

9.2 Contributions of the Study

The results of the study are considered to have made an important contribution to the academic literature on performance factors in the supply chain, as well as the improvement of the beef industry as a sector of the overall agri-food industry in Australia as outlined below.

9.2.1 To the Literature

From this study, the most important contribution to the literature was the development of a comprehensive, reliable, and valid model of Australian Beef Industry Supply Chain performance through a combination of the qualitative interview and quantitative survey results. The hypotheses underlying the model were tested with PLS based structural equation modeling using 11 primary factors, 15 sub-factors and 81 observed variables. The empirical findings supported both the direction of theoretical underpinnings from the resource based view (RBV)/knowledge based view (KBV) and the transaction cost economics (TCE) that inter-organizational relationship structures and knowledge asset management can be considered as value creating strategic/economic resources and contribute to the performance and the competitiveness of an industry. Thus, the factors and variables that were used to measure supply chain performance in the study provided new knowledge to the strategic management and agri-food information systems literature.

Another important contribution of the research was the development of three statistically valid and reliable formative second order constructs: *vertical coordination*, *inter-firm relationship strength*, and s*upply chain performance*. Although literature provides evidence that these three constructs can be abstracted and aggregated using several key dimensions (first-order constructs/subconstructs) and there has been considerable research on individual dimensions, other than supply chain performance; the constructs had not been tested in an appropriately specified formative construct as discussed in Section 5.4.1.1. Using the key variables of TCE (such as asset specificity, information asymmetry, and contractual arrangement for the construct vertical coordination), the modeling of these relatively complex concepts in a composite higher order approach for empirical research can add new knowledge for the holistic presentation of the constructs, relative weightings and importance of each of the first-order dimensions, and their mediated effects in hypothesized relationships.

Similarly, the concept *knowledge asset management* was modelled as a second order construct but in a reflective direction, by combining five dimensions of knowledge management. This approach makes a contribution to the literature by explaining the relative importance (based on path loadings) of the dimensions to represent the higher order concept *knowledge asset management* in predicting the performance of the agri-food supply chain.

Other contributions to the literature from this research included the finding that IOS use is not a significant contributor of supply chain performance and competitiveness, which contrasted with most of the extant studies that used TCE and RBV frameworks and showed that IOS use can significantly influence the supply chain performance. The theoretical and practical reasons for the lack of IOS support identified in this research is that IOS, by itself, cannot produce sustained performance advantages unless pre-existing complementary human and business resources are exploited in an integrated way. As most of the sample firms in the research were small in size, and in the category of producers, there was a lack of understanding and interest in the use of IOS; it can produce positive advantage only in the presence of strong inter-firm relationships such as trust and interdependence for an embedded mutually reinforcing advantage.

Finally, the utilization of PLS based structural equation modeling (SEM) for assessing the research model and testing the hypotheses in the agri-food sector make a further contribution to the research in this field. Being more popular in information system research, PLS SEM as a second generation statistical tool can assess multiple relationships with multiple predictors and assess the model both in measurement relationships between indicators and the latent construct and structural hypothesized relationship between the latent constructs.

9.2.2 To the Practice

The two phase of the study (qualitative field study and quantitative survey) involved exploring the important factors of supply chain performance in the agri-food industry and testing some hypotheses targeting factors in the beef industry, so the result has a practical contribution to the overall agri-food industry in Australia. The study has identified significant performance factors, their application and implications for improving the agri-food supply chain; strategic and valuable information has been gleaned for use by the producers, processors, retailers, government departments, and other stakeholders. The research showed that knowledge asset management and inter-firm relationship strength are the most prevalent sources of supply chain performance and competitiveness and are influenced by the level of competition, vertical coordination, transaction climate, price uncertainty and negotiation power of a firm. Results also suggested that durable buyer-supplier relationships in a supply chain develop from the level of commitment and trust, interdependence and mutual investment; they are strategic economic resources to assist in bypassing the cost of traditional market transactions.

The research results demonstrated that collective organizations, vertical interactions and infrastructures of knowledge and services in the supply chain such as producers-processors' alliance, cooperative farmers' market and new technologies for improving transportation and communication capacities can enhance the performance and competitiveness of the industry. The operational adoption of a lean supply chain between producers and processors or processors and retailers, strong consolidation/integration of business activities, and synchronized information and knowledge flow through an organized vertical interactions, positive transaction climate, solid power bases and competitions at the industry level can be key success factors for improving profitability and sustainability in the agri-food industry. It has been shown that it is better to be a part of supply chain for an enhanced performance with an intention to compete against other supply chains rather than as a single firm competing against other individual firms.

Hence, the important practical implication of the study is that firms should build their supply chain as a substantial resource by developing and sharing their knowledge asset and by developing a cooperative relationship structure to become market-driven non-commodity based domestic and export market players. A cooperative knowledge-based relationship structure among the farmers/producers, processors, wholesalers, retailers and/or other partners in the supply chain will help to ensure sustainable and viable enterprises. It will help improve their firm-level innovation, specify the contingencies of supply and demand related problems and increase performance and competitiveness.

The results of the study, therefore, not only contribute to the operational level by enhancing understanding of supply chain knowledge management and inter-firm relationship factors that drive the supply chain performance, but also contribute at the strategic level for appropriate planning and benchmarking to improve performance of the agri-food industry. The study provides frameworks for developing the strategies of inter-firm relationships, knowledge asset management and the use of electronic systems in the supply chain to align the best principles of value creating strategy in firms, and in the industry, for competitive advantage.

9.3 Limitations and Indications for Future Study

This study was triggered by a small number of empirical works on performance issues in the Australian agri-food industry and initiated a series of related investigations by the researcher into agricultural information systems. Although, the hypothesized relationships in the model have been tested in the beef industry in Australia, the issues can be examined not only in other sectors of the Australian agri-food industry supply chain but also in other agricultural sectors within Australia and overseas. The supply chain model may also be investigated in non-agricultural industries.

However, there are specific limitations to the study where future works can be made. Firstly, the methodology used in the study did not address the research problem based on the size differences among supply chain firms, which may be an important issue for gauging differences in the performance of the supply chain. Although, most of the hypothesized relationships were statistically significant, application of a quota system to collect a proportionate sample of participants based on the sizes of firms and splitting of the sample into two data sets (between small-medium and large firms) for further PLS analysis would yield worthwhile results. In some cases independent sample t-tests based on firm size were conducted to elaborate the implications of the results, as given in Chapter 8, though in future research the data set could be split into different groups of respondents (e.g., producers, processors and suppliers) or within regions of WA and Queensland to cross examine the model in PLS and compare the performance to generate further insight into groups with high performance.

Secondly, the constructs of vertical coordination, price uncertainty, negotiation power and competition intensity in the industry are not new concepts, although most of the items of these constructs were new because of the unavailability of established measures in the academic literature; they were identified from the frameworks of TCE and from the findings of the field study. As the nature of the study was exploratory, there were some limitations in following all the procedures for developing new measures in this study. Future studies may well investigate by incorporating more complex patterns of vertical coordination, levels of competition, and uncertainty issues in the spectrum of coordination such as in auction/open market transactions, strategic alliances or the vertical integration of the supply chain.

In this study, the researcher also did not attempt to test how *knowledge asset management, IOS use,* and *Inter-firm relationship strength* can mediate the impact of the three exogenous variables *competition intensity, vertical coordination,* and *transaction climate* on *supply chain performance.* Future studies are recommended to assess the direct effects and strength of these exogenous variables by conducting a mediation test and comparing effect sizes based on the changes in R^2. Moreover, effects from each of the first-order constructs could be explored in relation to supply chain performance. A good example of calculating effect sizes can be found in Chin (2003).

Thirdly, compromises were made to meet the requirements of the structural equation model and the length of questionnaire in telephone interviewing; e.g., to prevent non-responses the ideal questionnaire should not take more than 20 minutes to complete for which some of the sub-constructs of inter-firm relationship strength and knowledge asset management only used two items (questions) while subjective measures are used for all the constructs (although results are replicated with important objective measures). Consequently, future studies may be undertaken to include more items for those sub-constructs and could include other objective measures of firm performance to achieve more flexibility in analysis.

Fourth, there were challenges in doing a cross-sectional study among the members of a supply chain given the practicalities of survey instrument design where a firm may have both the role of a buyer and supplier, and have different views of relationships and performance objectives. The measures that address vertical coordination and inter-firm relationship issues were not longitudinal and, therefore, lacked a complete understanding of the time required for developing a favorable relationship structure such as building interdependence and strategic alliances for better performances. Therefore, in future, research may look at a more longitudinal view of vertical coordination and relationship strength in supply chains.

Finally, given the available funds, targeted respondents and objectives of the research, the study had a small geographic coverage: the qualitative data were gathered from the state of Western Australia (WA) and the quantitative data were collected from WA and Queensland (QLD); with reasons for selecting the sample given in Chapter 3. While the main focus of this study was on WA, much of the national industry information was linked to QLD among the other six states of Australia. In terms of beef production, industry structure and export, QLD ranked first, New South Wales (NSW) second, Victoria third, and WA ranked fourth (MLA, 2008a). Therefore, it would be useful to extend the research to cover the opinions of the firms in NSW and Victoria. Future studies may include these states and test the value of the supply chain performance model in all states.

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Appendix 1 Field Study Interview Guide

- Start off by thanking the participant for taking part in the research.

- Explain that everything discussed in this interview is confidential and any evidence
- published from the interview will not make any connection to the participant's name
  or business.
- The interview can be paused or terminated at any time without prejudice.
- Any statements that the participant does not want to be recorded can be omitted from the tape.

Supply Chain (SC) Transaction Structure

Q1. Could you please detail about your organization's SC governance structure, **i.e. the formation and arrangement of supply chain transaction with other organizations** (farmers/producers, wholesalers, processors, retailers, etc.). Specifically, what are the formal and informal ways you are maintaining supply chain of your food products?

a) Do you think contracting, relation specific investments **(any investment that you made for maintaining SC relation)** are the suitable ways of making formal relation with your SC members? Is there any other effective ways of making transactions.
   Probe: Could you pls give your company's example?

b) Do you believe trust, **strength of your bargaining/market power (capability to receive obedience),** or any other social ties has important informal role in making SC transaction?
   Probe: Could you pls give any example of your experience?

c) Pls comment how your SC transaction structure (governance structure/arrangement) affects your SC performance
   Probe: Whether your transaction structure/climate has any role on the use of IOS and on the performance of your SC

Q1-1. In your opinion, what are the uncertainties/risks in the structure of your supply chain transactions?
Probe:
a) Do you ever experience arbitrarily change of the terms of contracts, breaking up the contracts using market/bargaining power of the parties, causing hold-up problems, and so on.
b) Could you give some examples in relation to your company, how it effects and how you manage?

Use of Inter-Organizational System (IOS)

Q2. Could you pls tell about the systems (manual/electronic such as EDI, Internet, Websites, Radio tracking, etc) through which you are maintaining inter-organizational relationships in supply chain?

Probe: Pls Comment about the number of transaction and the interpenetration of the business processes through IOS.

Q2-1. Do you think use of IOS has a positive role in the performance of your supply chain?

Probe: If possible please give some examples of benefits using IOS?

Knowledge Asset

Q3. Please tell about the initiatives of your organization to utilize knowledge in supply chain?

Probe: 'know how' or 'procedural knowledge' on SC process, flow of knowledge/information among SC members, use of any business intelligence.

a) How you acquire/create and store SC knowledge.

b) How you share knowledge between SC participants

c) How you utilize knowledge in different SC processes

(For your convenience, A table of SC process oriented knowledge is given at the end)

Q3-1. Do you think your Knowledge assets have significant influence in your food supply chain?

Probe: Influence on your SC transaction structure as well as on SC Performance. If possible please provide some scenarios of using knowledge in the supply chain

External Factors related to SC

Q4. What are the external factors influencing you to use IOS and develop knowledge assets in the supply chain?

Probe: For example, the factors such as uncertainty in the demand, presence of industry competitors, and your technological policy may enable you to achieve competitive advantage in supply chain.

Supply Chain Performance Indicators

Q5. Do you use any indicators/standards for evaluating your supply chain performances?

Probe: Could you pls tell whether your organization use any financial and non-financial variables to measure actual performance or perception of performance?

Appendix 2(i) Survey Questionnaire (the version for Producers/Processors/Abattoirs/Exporters/Input Suppliers

Beef producer/processor/input supplier name: ……………………………………………..
Code Number:…………Phone Number:…………………… …………..Locality and area code ………………………………………..

Hello Mr/Mrs …………………… I am calling on behalf of the Curtin University of Technology and Department of Agriculture and Food, Western Australia. We are conducting a survey to understand more about the factors influencing your business performance in the beef industry supply chain. Would you mind assisting us by answering some short questions? It will take about 15-20 minutes and all answers will remain strictly confidential. The scale of answer, in all questions, is from 1 to 7.

<u>How the Study will benefit you</u>

It is believed that the competitiveness and performance of the meat industry depends on improving cost efficiency and productivity which requires a study of whole of supply chain and relationships among the participants. This study will identify the key issues in governing your buyer-seller relationships, inter-firm contracts, information/knowledge sharing, and uncertainty in the business transactions. It will also identify how these issues are impacting on your profitabilility, viability, and competitiveness; and therefore, overall performance of your business. Thus, the outcome of this study will enable the industry stakeholders and government departments to do appropriate planning and benchmarking to improve performance of the industry.

Section 1: Industry Segmentation

Q 1. Does your business fall in any of the following categories of beef industry

Beef-Cattle Producer/Farmer …. 1	**Ask Q. 2 as well**
Beef meat Processor/abattoir… 2	**Go to Section 2, Q. 1**
Beef Retailer/Exporter … 3	
Wholesaler … 4	
Input supplier (e.g. feed, livestock, transport) … 5	

*** Beef retailer can be a butcher shop, a supermarket store of Woolworths, Coles, IGA, among many others

*** Input supplier to beef industry can be a grain or feed supplier, transportation, fertilizer, livestock supplier

Q 2. If a Primary producers, do you currently have a minimum of 100 beef-cattle?

Yes – Go to Section 2	**No** " I'm sorry to interrupt you" – "Thank You"

Section 2: Factors Influencing Beef Supply Chain performance

Q 1. The following are some of the factors that may influence your business. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate ...

Strongly Disagree ↔ Strongly Agree

CP1	Competition in our industry is intense	1	2	3	4	5	6	7
CP2	We aggressively try to hold on to our share of the market (e.g. by competitive strategies, innovation)	1	2	3	4	5	6	7
CP3	We have an aggressive policy of using technology to remain competitive	1	2	3	4	5	6	7
EV1	We have high animal welfare standards in both production and transportation	1	2	3	4	5	6	7
EV2	We minimize environmental impact by efficient use of resources (Power/water/materials).	1	2	3	4	5	6	7

<u>Most of the following questions are based on your experience of business transaction with your major buyers/suppliers in the Supply Chain</u>

Q 2. Please indicate how you organize transactions with your customers in the supply chain. On a scale of 1-7, where 1 is never and 7 as Very often, how would you rate …?

Never ↔ Very Often

CD1	We have high level of coordination on sales date, delivery times and other transactions with our major buyers	1	2	3	4	5	6	7
CD2	We have had investment in our company's asset from our major buyers	1	2	3	4	5	6	7
CD3	We often share information that affects our business with our major buyers	1	2	3	4	5	6	7

Q 2.a. We trade with our buyers on the basis of

Never ↔ Very Often

FT1	Spot Market	1	2	3	4	5	6	7
FT2	Short term contract	1	2	3	4	5	6	7
FT3	Long Term Contract	1	2	3	4	5	6	7

Then how do you trade with your suppliers

Never ↔ Very Often

FT1a	Spot Market	1	2	3	4	5	6	7
FT2a	Short term contract	1	2	3	4	5	6	7
FT3a	Long Term Contract	1	2	3	4	5	6	7

***** If both VC4b and VC4c are never, then skip Q 2.b and go to Q. 3**

Q 2.b. In the contract how do you do business with your majors buyers. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

CA1	Our major buyers are obliged to market our production	1	2	3	4	5	6	7
CA2	Our major buyers specify production practices and quality of our production	1	2	3	4	5	6	7
CA3	Our major buyers have full control on our production (e.g. provide key inputs, resources)	1	2	3	4	5	6	7

Q 3. The following statements are related to your bargaining or market power. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

NP1	We have enough influence on the supply chain to negotiate price	1	2	3	4	5	6	7
NP2	Having to take whatever price offered by the buyers is a great problem	1	2	3	4	5	6	7
NP3	We enjoy other economic benefits, in addition to price, from our relationship with our buyers (e.g. determining place and time of delivery)	1	2	3	4	5	6	7

Q 4. The following statements indicate the level of uncertainty your business faces in its supply chain. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

PU1	Over time and season, the supply of beef-cattle or meat fluctuates widely	1	2	3	4	5	6	7
PU2	We feel that Carcass specification system (Weight, fat, conformation) strongly influences our product price.	1	2	3	4	5	6	7
PU3	We need to inspect beef-cattle or meat closely to ensure quality and grade	1	2	3	4	5	6	7
PU4	We believe that we are not getting enough margin from our sales	1	2	3	4	5	6	7
PU5	Price fluctuation for our products is a real management problem	1	2	3	4	5	6	7
PU6	There is significant uncertainty in the demand for beef-cattle/meat products	1	2	3	4	5	6	7

Q 5. Please indicate 1 as Never and 7 as very often if you have joint venture-investment or other business activities between your business unit and your major buyer in terms of:

Never ↔ Very Often

MI1	People and time (e.g. providing expertise to develop your product/service)	1	2	3	4	5	6	7
MI2	Capital	1	2	3	4	5	6	7
MI3	Processes, infrastructure, facilities, technologies	1	2	3	4	5	6	7

Q 6. The following are some statements regarding the level of your relationships with your major buyers/suppliers in the supply chain. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

IP1	If I wanted to, I could switch to another buyer easily	1	2	3	4	5	6	7
IP1a	If I wanted to, I could switch to another supplier easily	1	2	3	4	5	6	7
IP2	Our buyer would face severe business disruption if we ended our relationship	1	2	3	4	5	6	7
IP2a	Our supplier would face severe business disruption if we ended our relationship	1	2	3	4	5	6	7
CN1	We prefer contracts for profitability and planning security	1	2	3	4	5	6	7
CN2	We prefer long-term to short-term contracts	1	2	3	4	5	6	7
CN3	Selling price is always specified in our contracts	1	2	3	4	5	6	7
TR1	Our buyer honors all agreements with us	1	2	3	4	5	6	7
TR1a	Our supplier honors all agreements with us	1	2	3	4	5	6	7
TR2	We believe our buyers would not deliberately take a course of action that affect us negatively	1	2	3	4	5	6	7
TR2a	We believe our suppliers would not deliberately take a course of action that affect us negatively	1	2	3	4	5	6	7
CM1	We have a high level of business commitment to our buyers	1	2	3	4	5	6	7
CM2	We have a high level of business commitment to our suppliers	1	2	3	4	5	6	7

Q 7. The following are some statements regarding the existing situation of your supply chain relationships. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

TC1	Our goals are well aligned and compatible with our major buyers	1	2	3	4	5	6	7
TC1a	Our goals are well aligned and compatible with our major suppliers	1	2	3	4	5	6	7
TC2	We have a very good understanding of each others business (e.g. needs, limitations, expectations)	1	2	3	4	5	6	7
TC3	We share business risks, burden, and benefits of transaction with our buyers	1	2	3	4	5	6	7
TC3a	We share business risks, burdens, and benefits of transaction with our suppliers	1	2	3	4	5	6	7

Section 3: Electronic System Use

Q 9. The following are some statements regarding your use of electronic systems such as Electronic Data Interchange (EDI) in the supply chain transactions. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

IS1	A high percentage of our total transactions with buyers are conducted through electronic system	1	2	3	4	5	6	7
IS2	We can transfer files electronically to our buyers' systems	1	2	3	4	5	6	7
IS3	Our system can access our buying partner's database	1	2	3	4	5	6	7
IS4	In most of the transactions, our system and partner's system are compatible to communicate with each other	1	2	3	4	5	6	7

Q 10. Please indicate the extent to which you exchange electronic data/information in the following functions with your buyers. On a scale of 1 to 7 where 1 is Never and 7 as very often, how would you rate...

Never ↔ Very Often

IS5a	Purchasing/Ordering	1	2	3	4	5	6	7
IS5b	Quality Control	1	2	3	4	5	6	7
IS5c	Production Control	1	2	3	4	5	6	7
IS5d	Transportation	1	2	3	4	5	6	7
IS5e	Payment	1	2	3	4	5	6	7

Section 4: Knowledge Asset (Data, Information, Market Intelligence)

Q 11. Please indicate the level to which you use knowledge (data, information, experience) in managing your supply chain. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

AL1	We collect data on our customers, product prices, and distribution channels	1	2	3	4	5	6	7
AL2	We do a lot of in-house research on products we may produce or sell	1	2	3	4	5	6	7
AL3	We regularly meet to find what products and or partners we may need in future	1	2	3	4	5	6	7
AL4	We spend a great deal of time and resources learning about our supply chain	1	2	3	4	5	6	7
AC1	Supply chain knowledge that we have is easily accessible when needed	1	2	3	4	5	6	7
AC2	It is easy to obtain supply chain related knowledge from key people in our organizations	1	2	3	4	5	6	7
SM1	We share supply management information effectively with our buyers	1	2	3	4	5	6	7
SM2	We frequently have meetings (within firm or inter-firm) to discuss current trends and future need on supply	1	2	3	4	5	6	7

	management							
US1	We use supply chain knowledge to improve our sales' of business	1	2	3	4	5	6	7
US2	We use our supply chain knowledge to improve our products	1	2	3	4	5	6	7
US3	Our existing supply chain knowledge reduced the uncertainty of our business	1	2	3	4	5	6	7
US4	We use our Supply chain knowledge to improve the relationship with our customers	1	2	3	4	5	6	7
MM1	We have good systems to store and use our knowledge on supply chain	1	2	3	4	5	6	7
MM2	We have a great deal of knowledge to deal with our buyers/suppliers							

Section 5: Performance and Competitiveness

Q 12. The following are some items to measure the level of your firm's performance in the supply chain. Please indicate how your firm has performed over the last 3 years. On a scale of 1 to 7, where 1 is 'Decreased significantly' and 7 as 'Increased significantly', how would you rate…

Decrease Significantly ↔ Increase Significantly

CF1	The ability to fulfill order in specified quality and quantity of items	1	2	3	4	5	6	7
CF2	Ability to fulfill order delivery on time (from the receipt of order to delivery)	1	2	3	4	5	6	7
CF3	Ability to respond to customers queries	1	2	3	4	5	6	7
IF1	Improvement of product/service quality	1	2	3	4	5	6	7
IF2	Production, transportation and marketing cost of your business	1	2	3	4	5	6	7
IF3	Your access to working capital	1	2	3	4	5	6	7
IF4	Your return from the fixed asset	1	2	3	4	5	6	7

Q 13. The following statements are regarding the competitiveness of your firm. Please indicate 1 as strongly disagree and 7 as strongly agree, approximately based on your last three years data.

Strongly Disagree ↔ Strongly Agree

CMP1	Our cost efficiency has improved more than that of our main competitors	1	2	3	4	5	6	7
CMP2	We achieved better productivity than that of our main competitors	1	2	3	4	5	6	7
CMP3	Our Market share has increased faster than that of our main competitors	1	2	3	4	5	6	7
CMP4	We achieved better product differentiation and innovation than our most important competitors	1	2	3	4	5	6	7

****Competitors can be national or international firms**

Section 6: Information about You and your Firm

Please answer the questions below by nominating the most appropriate response

1. What is the location of your firm?[DD1] --

2. You position/role in your firm [DD2]

Owner …. 1
Supply Chain Manager … 2
Executive/Officer …3
Logistic/Distribution Controller …4
Other …. 5

3. The total number of employees in your firm [DD3] ---

4. Your firm's average annual revenue during the last three years [DD5]
5.

< 1 million …. 1
1-5 million … 2
6-10 million …3
11-20 million …4
>20 million …. 5

6. In terms of growth, indicate your organization status [DD7]

Growing … 1
Matured … 2
Established and trying to get bigger … 3
Shrinking … 4
Just surviving …5
Winding up/selling/going broke … 6

7. Where would you like to see your business in the next 5 years in terms of your income/ and or market share

Income ……….
Market share ………..

7. If you are a producer, how many beef cattle do you have? [DD4]

100-400 head … 1
401-800 head … 2
801 – 1600 head … 3
>1600 head … 4

Appendix 2(ii) Survey Questionnaire (the version for wholesalers/retailers)

Section 1: Industry Segmentation

Q 1. Does your business fall in any of the following categories of beef industry

Beef-Cattle Producer/Farmer …. 1	**Ask Q. 2 as well**
Beef meat Processor/abattoir… 2	**Go to Section 2, Q. 1**
Beef Retailer/Exporter … 3	
Wholesaler … 4	
Input supplier (e.g. feed, livestock, transport) … 5	

*** Beef retailer can be a butcher shop, a supermarket store of Woolworths, Coles, IGA, among many others

*** Input supplier to beef industry can be a grain or feed supplier, transportation, fertilizer, livestock supplier

Q 2. If a Primary producers, do you currently have a minimum of 100 beef-cattle?

Yes – Go to Section 2	**No** " I'm sorry to interrupt you" – "Thank You"

Section 2: Factors Influencing Beef Supply Chain performance

Q 1. The following are some of **the factors that may influence your business**. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate ...

Strongly Disagree ↔ Strongly Agree

CP1	Competition in our industry is intense	1	2	3	4	5	6	7
CP2	We aggressively try to hold on to our share of the market (e.g. by competitive strategies, innovation)	1	2	3	4	5	6	7
CP3	We have an aggressive policy of using technology to remain competitive	1	2	3	4	5	6	7
EV1	Our supplier should have high animal welfare standards in both production and transportation	1	2	3	4	5	6	7
EV2	We minimize environmental impact by efficient use of resources (Power/water/materials)	1	2	3	4	5	6	7

Most of the following questions are based on your experience of business transaction with your major suppliers in the Supply Chain

Q 2. Please indicate how you organize transactions with your suppliers. On a scale of 1-7, where 1 is Never and 7 as Very often, how would you rate …

Never ↔ Very Often

CD1	We have high level of coordination on sales date, delivery times and other transactions with our suppliers	1	2	3	4	5	6	7
CD2	We have had investment in our company's asset from our major suppliers	1	2	3	4	5	6	7
CD3	We often share information that affects our business with our suppliers	1	2	3	4	5	6	7

Q 2.a) We trade with our suppliers on the basis of

Never ↔ Very Often

FT1	Spot Market	1	2	3	4	5	6	7
FT2	Short term contract	1	2	3	4	5	6	7
FT3	Long Term Contract	1	2	3	4	5	6	7

Then how do you trade with your buyers?

Never ↔ Very Often

FT1a	Spot Market	1	2	3	4	5	6	7
FT2a	Short term contract	1	2	3	4	5	6	7
FT3a	Long Term Contract	1	2	3	4	5	6	7

***** If both VC4b and VC4c are never, then skip Q 2.b and go to Q. 3**

Q 2.b) In the contract how do you do business with your majors suppliers. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

CA1	We are obliged to market our major suppliers' production	1	2	3	4	5	6	7
CA2	We specify production practices and quality of our major suppliers' production	1	2	3	4	5	6	7
CA3	We have full control on our major suppliers' production (e.g. we provide key inputs, resources)	1	2	3	4	5	6	7

Q 3. The following statements are related to your bargaining or market power. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

NP1	We have enough influence on the supply chain to negotiate price	1	2	3	4	5	6	7
NP2	Determining price with our suppliers is not a great problem	1	2	3	4	5	6	7
NP3	We enjoy other economic benefits, in addition to price, from our relationship with our suppliers (e.g. determining place and time of delivery)	1	2	3	4	5	6	7

Q 4. The following statements indicate the level of uncertainty your business faces in its supply chain. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate...

Strongly Disagree ↔ Strongly Agree

PU1	Over time and season, the supply of beef fluctuates widely	1	2	3	4	5	6	7
PU2	We feel that Carcass specification system (Weight, fat, conformation) strongly influences our product price.	1	2	3	4	5	6	7
PU3	We need to inspect beef-meat closely to ensure quality and grade	1	2	3	4	5	6	7
PU4	We believe that we are not getting enough margin from our sales	1	2	3	4	5	6	7
PU5	Price fluctuation for our products is a real management problem	1	2	3	4	5	6	7
PU6	There is significant uncertainty in the demand for our meat product	1	2	3	4	5	6	7

Q 5. Please indicate 1 as Never and 7 as very often if you have joint venture-investment or other business activities between your business unit and your major supplier in terms of:

Never ↔ Very Often

MI1	People and time (e.g. providing expertise to develop your product/service)	1	2	3	4	5	6	7
MI2	Capital	1	2	3	4	5	6	7
MI3	Processes, infrastructure, facilities, technologies	1	2	3	4	5	6	7

Q 6) The following are some statements regarding the level of your relationships with your major suppliers/buyers in the supply chain. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate ...

Strongly Disagree ↔ Strongly Agree

IP1	If I wanted to, I could switch to another buyer easily	1	2	3	4	5	6	7
IP1a	If I wanted to, I could switch to another supplier easily	1	2	3	4	5	6	7
IP2	Our buyer would face severe business disruption if we ended our relationship	1	2	3	4	5	6	7
IP2a	Our supplier would face severe business disruption if we ended our relationship	1	2	3	4	5	6	7
CN1	We prefer contracts for profitability and planning security	1	2	3	4	5	6	7
CN2	We prefer long-term to short-term contracts	1	2	3	4	5	6	7
CN3	Selling price is always specified in our contracts	1	2	3	4	5	6	7
TR1	Our buyer honors all agreements with us	1	2	3	4	5	6	7
TR1a	Our supplier honors all agreements with us	1	2	3	4	5	6	7
TR2	We believe our buyers would not deliberately take a course of action that affect us negatively	1	2	3	4	5	6	7
TR2a	We believe our suppliers would not deliberately take a course of action that affect us negatively	1	2	3	4	5	6	7
CM1	We have a high level of business commitment to our buyers	1	2	3	4	5	6	7
CM2	We have a high level of business commitment to our suppliers	1	2	3	4	5	6	7

Q 7. The following are some statements regarding the existing situation of your supply chain relationships. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate ...

Strongly Disagree ↔ Strongly Agree

TC1	Our goals are well aligned and compatible with our major buyers	1	2	3	4	5	6	7
TC1a	Our goals are well aligned and compatible with our major suppliers	1	2	3	4	5	6	7
TC2	We have a very good understanding of each others business (e.g. needs, limitations, expectations)	1	2	3	4	5	6	7
TC3	We share business risks, burden, and benefits of transaction with our buyers	1	2	3	4	5	6	7
TC3a	We share business risks, burdens, and benefits of transaction with our suppliers	1	2	3	4	5	6	7

Section 3: Electronic System Use

Q 9. The following are some statements regarding your use of electronic system such as Electronic Data Interchange (EDI) in the supply chain transactions. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate ...

Strongly Disagree ↔ Strongly Agree

IS1	A high percentage of our total transactions with suppliers are conducted through electronic system	1	2	3	4	5	6	7
IS2	We can transfer files electronically to our suppliers systems	1	2	3	4	5	6	7
IS3	Our system can access our suppliers database	1	2	3	4	5	6	7
IS4	In most of the transactions, our system and suppliers system are compatible to communicate with each other	1	2	3	4	5	6	7

Q 10. Please indicate the extent to which you exchange electronic data/information in the following functions with your suppliers. On a scale of 1 to 7 where 1 is Never and 7 as very often, how would you rate...

Never ↔ Very Often

IS5a	Purchasing/Ordering	1	2	3	4	5	6	7
IS5b	Quality Control	1	2	3	4	5	6	7
IS5c	Production Control	1	2	3	4	5	6	7
IS5d	Transportation	1	2	3	4	5	6	7
IS5e	Payment	1	2	3	4	5	6	7

Section 4: Knowledge Asset (data, Information, market intelligence)

Q 11. Please indicate the level to which you use knowledge (data, information, experience) in managing your supply chain. On a scale of 1 to 7 where 1 is strongly disagree and 7 as strongly agree, how would you rate…

Strongly Disagree ↔ Strongly Agree

AL1	We collect data on our customers, product prices, and distribution channels	1	2	3	4	5	6	7
AL2	We do a lot of in-house research on products we may produce or sell	1	2	3	4	5	6	7
AL3	We regularly meet to find what products and or partners we may need in future	1	2	3	4	5	6	7
AL4	We spend a great deal of time and resources learning about our supply chain	1	2	3	4	5	6	7
AC1	Supply chain knowledge that we have is easily accessible when needed	1	2	3	4	5	6	7
AC2	It is easy to obtain supply chain related knowledge from key people in our organizations	1	2	3	4	5	6	7
SM1	We share supply management information effectively with our suppliers	1	2	3	4	5	6	7
SM2	We frequently have meetings (within firm or inter-firm)	1	2	3	4	5	6	7

	to discuss current trends and future need on supply management							
US1	We use supply chain knowledge to improve our sales' of business	1	2	3	4	5	6	7
US2	We use our supply chain knowledge to improve our products	1	2	3	4	5	6	7
US3	Our existing supply chain knowledge reduced the uncertainty of our business	1	2	3	4	5	6	7
US4	We use our Supply chain knowledge to improve the relationship with our suppliers	1	2	3	4	5	6	7
MM1	We have good systems to store and use our knowledge on supply chain	1	2	3	4	5	6	7
MM2	We have a great deal of knowledge to deal our buyers/suppliers							

Section 5: Performance and Competitiveness

Q 12. The following are some items to measure the level of your firm's performance in the supply chain. Please indicate how your firm has performed over the last 3 year. On a scale of 1 to 7, where 1 is 'Decreased significantly' and 7 as 'Increased significantly', how would you rate…

Decrease Significantly ↔ Increase Significantly

CF1	The ability to fulfill order in specified quality and quantity of items as required	1	2	3	4	5	6	7
CF2	Ability to fulfill order delivery on time (from the point of order to delivery)	1	2	3	4	5	6	7
CF3	Ability to respond to customers queries	1	2	3	4	5	6	7
IF1	Improvement of product/service quality	1	2	3	4	5	6	7
IF2	Production, transportation and marketing cost of your business	1	2	3	4	5	6	7
IF3	Your access to working capital	1	2	3	4	5	6	7
IF4	Your return from the fixed asset	1	2	3	4	5	6	7

Q 13. The following statements are regarding the competitiveness of your firm. On a scale of 1 to 7, please indicate 1 as strongly disagree and 7 as strongly agree, approximately based on your last three years data.

Strongly Disagree ↔ Strongly Agree

CMP1	Our cost efficiency has improved more than that of our main competitors	1	2	3	4	5	6	7
CMP2	We achieved better productivity than that of our main competitors	1	2	3	4	5	6	7
CMP3	Our Market share has increased faster than that of our main competitors	1	2	3	4	5	6	7
CMP4	We achieved better product differentiation and innovation than our most important competitors	1	2	3	4	5	6	7

**Competitors can be national or international firm

Section 6: Information about You and your Firm

Please answer the questions below by nominating the most appropriate response

1. What is the location of your firm?[DD1] ---
---

2. You position/role in your firm [DD2]

Owner …. 1
Supply Chain Manager … 2
Executive/Officer …3
Logistic/Distribution Controller …4
Other …. 5

3. The total number of employees in your firm [DD3] --

4. Your firm's average annual revenue during the last three years [DD5]

< 1 million …. 1
1-5 million … 2
6-10 million …3
11-20 million …4
>20 million …. 5

5. In terms of growth, indicate your organization status [DD7]

Growing … 1
Matured … 2
Established and trying to get bigger … 3
Shrinking … 4
Just surviving …5
Winding up/selling/going broke … 6

6. Where would you like to see your business in the next 5 years time in terms of your income or market share?

Income ………….
Market Share ………..