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## **Understanding the Relationship between Product Specifications and Coordination in Agri-business Supply Chains: an Examination of the New Zealand Meat Industry**

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### **Abstract**

Two phenomena are occurring simultaneously within the agribusiness sector: customers are requiring tighter product specifications and agricultural chains are becoming more coordinated. However, the exact relationship between these two phenomena is not clear. This research explores that relationship.

Five New Zealand fresh meat chains were the focus of multiple case-study research, which used a chain-level (multi-dyadic) approach. Chains were assessed as to the nature of product specifications demanded at the end-customer level, as well as to the nature of inter-firm relationships. Interestingly, tighter product specifications in themselves do not lead to more coordinated chains; coordination seems to be linked to the level of effort required to meet product specifications.

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## **1. Introduction**

Dramatic changes are taking place in the agricultural food sector. Consumers are more aware of product diversity, safety, quality, and environmental issues (Saxowsky and Duncan, 1998) and, consequently, are demanding products with tighter specifications associated with characteristics such as quality, practicality, and environmental friendliness. Agribusiness firms are increasingly concerned about maintaining adequate supply of products, satisfying consumers, meeting stricter regulations, and surviving in a highly competitive environment. For instance, firms have established various types of arrangements with suppliers in different parts of the world in order to guarantee year-round supply to specific markets (Gifford, Hall, and Ryan 1998). In the same way, joint ventures have been put into place to quickly and efficiently pool resources in order to respond to changes in the market, without incurring long-term and risky capital investment (IRN Limited, 2001). Improved supply chain coordination represents one method being advocated to more efficiently and effectively use resources to respond to these changes in the agribusiness sector.

The concurrent demand for tighter product specifications and the rise of increasingly integrated agricultural chains are two noticeable phenomena that seem to be related. However, the exact relationship between these two events is still not clear. Some experts affirm that tighter and entirely coordinated chains in response to changes in agribusiness (e.g. tighter product specifications, increasing competition and food safety concerns) is not an inevitable destination for all agricultural chains (Boehlje, Schrader, and Akridge, 1998). Thus, the purpose of this paper is to explore the relationship between product specifications and supply chain structure, with particular emphasis on whether tighter product specifications can be associated with more integrated agribusiness chains, and the nature of the relationship between the two.

## **2. Research Framework**

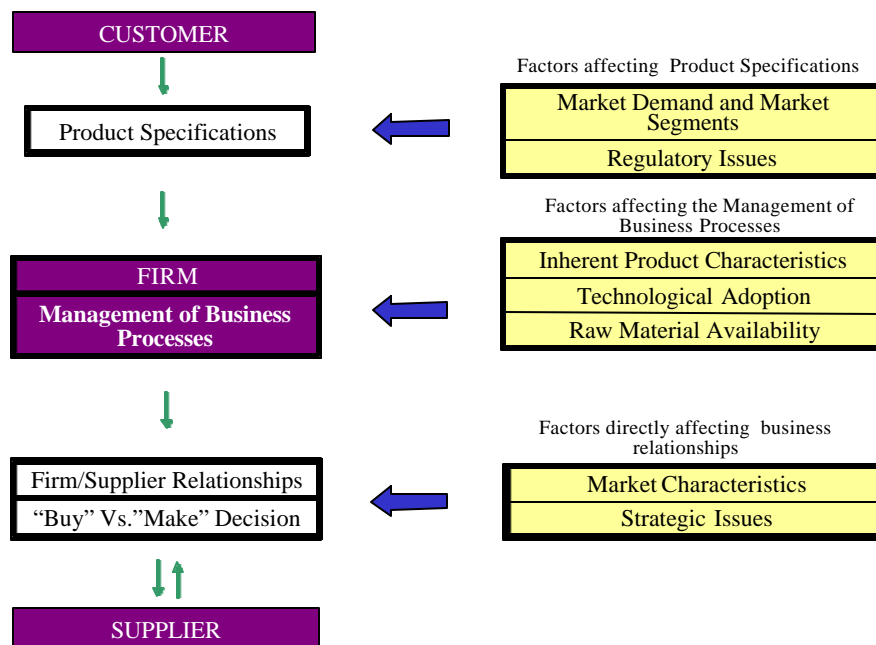
The research framework supporting the investigation focuses on the product specifications that customers demand from a firm, and how these specifications can affect inter-organizational relationships within the supply chain. Two continua are suggested to assess the status of product specifications and inter-firm relationships. The product specification continuum ranges from “loose” product specifications on one end, to “tight” product specifications on the other. The combination of the number and nature of requirements demanded by customers, the range of tolerance for the requirements, and the penalties or rewards that the customer establishes were the three basic elements taken into account to assess the status of the product specifications.

In its turn, the inter-firm relationships continuum ranges from the “Discrete” pole to the “Relational” pole, which is further extended to include Vertical Integration by

ownership (Dwyer, Schurr, and Oh, 1987; Peterson and Wysocki, 1998). At the Discrete pole, the exchange between parties is considered as impersonal as possible. Departing from the Discrete Relationship pole, the characteristics that express an increasing degree of closeness between two firms, such as level and frequency of information exchange, co-operative behavior (e.g. cross-teams), integration of business functions, joint-investments, trust and interdependence (Ellram and Hendrick, 1995), move the relationship towards the “Relational” pole (Cooper et al., 1997).

The two-continua framework is based on the logic that firms reach customers’ product specifications by managing their own business processes<sup>1</sup> as well as by influencing the business processes of suppliers through the relationships developed with them. Thus, the ability to meet customers’ product specifications involves “Make vs. Buy” decisions that affect the way firms relate to each other in the chain.

Incorporating the two continua into a broader context of agribusiness supply chains, Figure 1 suggests that the product specifications a firm receives from its customers depend on the customer’s demand, market demand and segment, and regulatory issues. Market demand and segment are a function of the firm’s strategic choice of the market(s) it aims to supply (Akridge et al., 1999), while regulatory issues are related to consumer and animal health and environmental issues that may trigger efforts related to traceability, liability, identity preservation and biological security (Hobbs and Young, 2000).



**Figure 1:** Factors Affecting the Firm’s Management of Business Processes and its Relationships with suppliers.

<sup>1</sup> Porter defines business processes as comprised by primary and secondary activities (Porter, 1980).

In turn, a firm's business processes are affected by the product specifications demanded by customers, the inherent characteristics of the product, technological adoption, and availability of raw materials. Inherent characteristics of the product, such as perishability (Hobbs and Young, 2000), as well as technological adoption (Saxowsky and Duncan, 1998) may affect business processes by demanding a higher level of business process integration between firm and supplier. This integration would be the response to situations, such as the presence of asset specificity, and interdependence of process and/or raw material at the firm-supplier interface. These aspects affect the firm's "Make or Buy" decision, which affects the kind of inter-firm relationship that the firm and its supplier establish.

Lastly, the relationship between firm and supplier can be also affected by their strategic orientation (Laios and Moschuris, 1999). This orientation may include efforts to respond to future market and consumer signals (Market Characteristics), to act and react against competitors, to build capabilities to ensure more efficient product and distribution systems, and to reduce costs (Copacino, 1997).

Two underlying theoretical propositions were established to guide the research. These were: (1) the customer's demand for tight product specifications may lead to the development or use of special procedures<sup>2</sup> to manage firm's business processes; and (2) the development of special procedures may lead to the establishment of firm-supplier relationships that can be characterized as relational exchange or vertical integration. If these propositions hold, then it would be expected that tight product specifications would lead to more coordinated chains. These two broad propositions encompass minor propositions relating product specifications to aspects involved in production processes, such as raw material dependence, integration and asset specificity. These aspects then would affect inter-firm relationships.

### **3. Methodology**

Because of the research focus on chain-level issues and inter-relationships between firms within agribusiness chains, the desired unit of analysis was the chain itself, with intra-chain dyads (pairs of buyer-supplier firms) comprising sub-units of analysis. Due to this complexity, a qualitative research design was deemed appropriate. A multiple case approach (Yin, 1994) was adopted, applying the research framework highlighted in the previous section to as many dyads as possible along each chain studied, so as to bring chain level issues to light.

The case study method was deemed appropriate because: (1) the research questions are concerned about *how* and *why* agribusiness chains may become more integrated; and (2) the changes and re-structuring of agribusiness chains represents a

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<sup>2</sup> The term "special procedures" means the procedures that demand specific training or investment in technology, production systems, machinery, or personnel; integration; and that are not common practices in the industry or sector of focus.

contemporary phenomenon, which includes present behavioral aspects and involve several contextual variables that would be difficult to control (Yin, 1994; Sterns, Schweikhardt, and Peterson, 1998). In order to investigate different situations, a multiple-case study approach was adopted (i.e. different chains were explored). A Case Study Protocol was developed to ensure transparency and rigor in the research procedures. This protocol involved the definition of the basic research questions, theoretical propositions, number of cases and unit of analysis, data sources and sampling, questionnaires and interviews, and case study sites.

Data were gathered through in-depth interviews with key persons in the firms, which included questioning about customer's demand, firm's business processes, firm's demand from its supplier as well as the characteristics of the firm's relationship with a customer and a supplier. In each case study, most of the chain firms from farm-level production up to retailing level were interviewed. In total, 21 in-depth interviews (average time of 1 hour) were performed for the five chains explored. In addition, some follow-up interviews were performed to clarify doubts and ask additional questions.

Following Yin's framework (Yin, 1994), one chain was explored at a time; the findings and characteristics of the chain explored became the starting point for the following chain. The study of each chain involved data gathering and processing, information analysis and report writing. The interviews were recorded and then transcribed. The relevant part of the text was coded according to the procedures suggested by Miles & Huberman (1984). The analysis of the coded text aimed to get information to address the propositions. In the case study approach, propositions aim to guide the research investigation, bringing focus to the data-gathering phase. Thus, the aim is not to prove or disprove the propositions.

After the last chain exploration, a cross-case analysis was performed, which led to the main findings of the research. Five chains were explored inside the New Zealand domestic fresh meat market: two pork (commodity pork and specialized pork), one beef, one chicken, and one lamb meat chain (for a brief description of the chains see Appendix). The choice of fresh meat aimed to use a product that could be compared across chains, but that would present enough diversity to enrich the study findings.

#### **4. Results and Discussion**

Basic characteristics of the chains investigated allowed them to be classified into three kinds of profiles: a) supply-end vertically integrated chains, b) market-end vertically integrated chains, and c) a network chain.

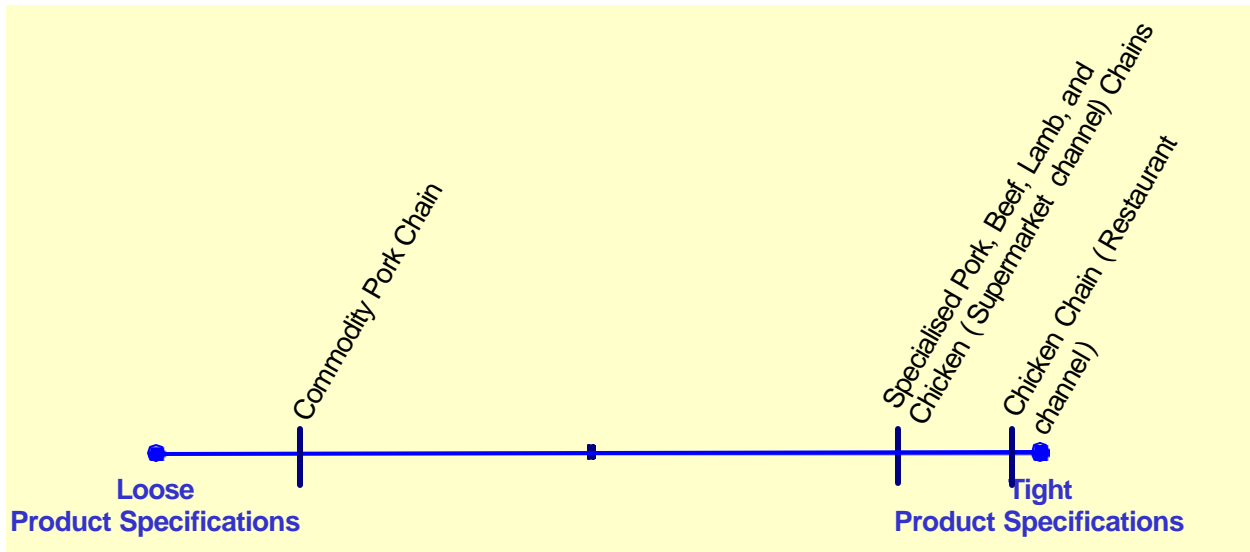
The supply-end vertically integrated chains included the commodity pork and chicken chains. These chains use vertical integration by ownership as the main coordination tool for managing the supply end of the chain. The vertical integrator

owns the animal breeding level and the meat processing and wholesaling levels, while establishing production contracts with growers for the animal finishing phase. The chains deliver the product to the commodity market, in which acceptable quality and low prices are the main desirable product characteristics. The relationships between vertical integrator and retailers can be characterized as discrete.

In the market-end vertically integrated chains (beef and lamb chains), vertical integration tool is used to manage the market end of the chain. These chains are coordinated by supermarket groups who own the meat processing, distribution, and retailing levels. Furthermore, the supermarket groups also integrate the finished animal procurement function, which then selects the animals on the open market using discrete relationships to facilitate this. The chain's products can also be considered commodities, with acceptable quality and low price are the main product characteristics.

Lastly, the network chain refers to the specialized pork chain. This chain presents a network configuration, in which firms have multiple contacts with other firms at different levels of the chain, mainly through the use of relational relationships. Chain levels are tightly integrated, highly interdependent, and deliver a differentiated product to a niche market. This happens because seemingly small procedures performed by sovereign firms strongly affect the quality and characteristics of the chain's end product. High quality and food safety are the main product characteristics delivered.

In addition to the development of the three profiles, analysis next extended to the two-continua framework. The exploration of each agribusiness chain and the performance of the cross-case analysis led to the assessment of the customer product specifications status for each chain, which was plotted on the product specification continuum (Figure 2).



**Figure 2:** Chain Level Product Specification Rank<sup>3</sup>

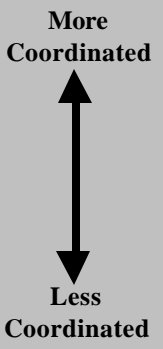
The definition of the inter-firm relationship status involved the analysis of the type of relationships established by each dyad that comprised a chain. This process led to the establishment of the number of Discrete and Relational Relationships, including Vertical Integration that each chain presented. Each inter-firm relationship was assessed by considering the different partnership components that each one presented. The level of coordination of a chain was assessed by taking into account the number of different relationships between the firms that comprise that chain. The higher the number of close relationships (Relational Relationships and Vertical Integration) a chain exhibits, the higher its degree of coordination. With this approach, the chains were ranked according to their level of collaboration (Table 1).

A comparison of the chain product specification rank (Figure 2) and the chain coordination rank (Table 1) reveals interesting situations related to the link between the product specifications and the level of chain coordination. When the chains that deliver tighter product specifications are put in the context of chain coordination, notice the interesting situation of the lamb and beef chains. While these chains delivered products with tight specifications, they have the lowest level of chain coordination among the cases studied. Thus, the fact that the chains deliver products with tight product specifications does not necessarily mean that chains are highly coordinated.

<sup>3</sup>The Chicken Chain was explored taking into account two different retailing channels; Supermarket and Restaurant channels.



**Table 1:** Chain Coordination Rank

Chain #	N. of Discrete Relationships	N. of Relational Relationships	N. of Vertical Integration	Rank
Specialised Pork	1	5	2	More Coordinated  Less Coordinated
Chicken (Restaurant Channel)	0	2	3	
Chicken (Supermarket Channel)	1	1	3	
Commodity Pork	1	2	2	
Lamb	1	1	2	
Beef	2	0	2	

In order to explain this result, it is necessary to return to the guiding propositions and to examine the chains using these propositions. The lamb and beef chains deliver meat to the New Zealand domestic fresh meat market, and some features of those industries appear to justify the unexpected combination of tight product specifications and relatively low level of coordination along the chain firms. In the first instance, these chains have access to a well-developed live animal market. Efficient farm and animal management allows beef farmers to offer animals in the open market that are high quality, particularly in terms of meat characteristics (e.g. tenderness), health status, and animal chemical treatment history. Furthermore, the size of the New Zealand beef and lamb market, due to the magnitude of the export market, also allows these chains to take advantage, not only of the overall quality, but also of the number and variety of animals on the open market. Together with this fact, Meat New Zealand (previously the New Zealand Meat Board) offers structure and know-how that allow the selection of quality meat and its conservation along the slaughtering, warehousing, distribution and retailing levels. For example, Meat New Zealand offers infra-structure that supports a quality seal (i.e. QMark) guaranteeing that the meat has been subject to tenderness tests, and food safety and quality procedures, such as the HACCP (Hazard Analysis Critical Control Points).

The specialized pork chain represents an interesting contrast to the beef and lamb chains. This chain relies on close relationships among chain firms to deliver a product exhibiting tight product specifications, as in the beef and lamb chains. In this situation, the delivery of high quality pork meat to a New Zealand domestic niche market relies on efforts of integration inside the chain. In this case, there is no availability of finished animals with the desired quality on the open market, and the chain relies on a single pork farm that applies special production procedures to guarantee high health and meat quality (e.g. tenderness) in the finished animals. In the same way, the slaughtering and meat processing stages of the chain utilize procedures that are not commonly applied in other pork chains, aiming to conserve the quality of the pork meat up to the retail level. Unlike the beef and lamb chains,

the specialized pork chain cannot rely on a well-developed industry structure, since the pork industry is still in the early stages of its development. This means the specialized pork chain does not have access to a large number of quality live animals, nor a well-developed support structure like the beef and lamb chains. Therefore, this specialized chain has to utilize its own resources to reach its goal of delivering high quality pork meat to end consumers.

In summary, the case study findings revealed that tight product specifications are not necessarily associated with the development of special procedures (Proposition 1). The delivery of tight product specifications may be possible by taking advantage of industry, sector or chain infrastructure, which may already be in place to support the delivery of those specifications. In this situation there is no need for the development of special procedures to meet tight product specifications. However, where it is necessary to develop special procedures to do this, the research findings point to their presence as the key aspect affecting inter-firm relationships (Proposition 2). In the presence of, or need for special procedures, integration and closer relationships between firms makes the delivery of tightly specified products possible.

## **5. Conclusion**

The research results revealed that the characteristics of the business processes involved in agribusiness chains appear to be a key factor affecting chains' coordination levels. The more highly coordinated chains have business processes that involved efforts (special procedures) to reach tight product specifications. Furthermore, these chains did not rely on a supporting industry structure or the presence of open markets to access product.

Taking into account the pressures on the agribusiness sector to improve quality, safety and diversity of food products, the research findings suggest that increasing chain coordination is not necessarily a natural trend for chains that intend to deliver tight product specifications. In some cases this may occur, but in others, the industry features, such as industry support and presence of open markets may mean that parts of the chains do not need to be so tightly coordinated. Future research needs to more closely examine the underlying factors leading to when and how agribusiness firms become more integrated in order to satisfy increasingly demanding customers.

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### **Appendix : Brief Description of the Chains Explored**

Five chains within the New Zealand domestic fresh meat market were explored. They were a specialized pork chain, a chicken chain, a commodity pork chain, a beef chain and a lamb chain.

The specialized pork chain satisfies a niche market for top quality pork in New Zealand. The efforts performed by the chain participants are aimed at offering quality pork in terms of health attributes and eating experience to end-consumers and restaurants. In this chain, the channel coordinator (or chain captain) is the pig farmer. The supplier of weaners sells the piglets to this pig farmer, who fattens the animals. The finished animals are slaughtered and the carcass is then processed into cuts. At this stage the meat receives the brand that belongs to the pig farmer. The product is then sent to registered butcheries and restaurants, and finally reaches the end consumer. The weaner supply and meat processing levels belong to the same firm, which is responsible for receiving the orders and payment from butcheries, and paying the pig farmer.

The chicken chain studied focuses on the production of broiler meat for the New Zealand domestic market. This chain has basically the same characteristics as other New Zealand broiler chains. The fertile grandparent eggs are imported from genetic breeding companies overseas, and the breeding process for the broilers' grandparents and parents takes place in New Zealand. The day-old broiler chicks are reared by broiler growers through contracts. The finished animals are then slaughtered and undergo some extra handling (e.g. packing) or processing (e.g. marinating, and smoking). The final product is distributed to supermarkets who then sell the chicken meat, or restaurants and catering companies who further

process the meat before sale to their consumers. Two different retail channels were explored: the supermarket and restaurant channels. The relationship with the supermarket is an open market arrangement, where the supermarket buys from a number of broiler companies, all of which offer similar product in terms of high quality and safety. With respect to the restaurant channel, the chicken company is the exclusive supplier of the product and has to deliver a product with strict specifications defined by a detailed contract. This chicken chain exhibits a high degree of vertical integration by ownership, in which the breeding, feed milling, slaughtering, and meat processing are done by the same firm.

The commodity pork chain is dedicated to the production of pork for the New Zealand commodity market. The main chain retailers are the supermarket groups. The pork is supplied in carcasses or cuts depending on the retailers' demand. The channel coordinator (chain captain) is the firm that supplies the weaner to pig farmers under contract, and then slaughters and processes them and sells the meat (in cut or carcass form) to supermarkets. This firm retains ownership of the product from animal breeding up to, and including, the meat processing level. The pork products produced are purely a commodity, with trade between retailers and suppliers done on a weekly basis, and these suppliers (pork companies) can be easily changed by the supermarkets without loss of quality.

The beef chain supplies quality beef to supermarkets that are prepared to pay a higher price for quality and food safety attributes. These attributes are ensured by a quality standard (New Zealand Beef and Lamb Quality Mark) and a food safety standard (HACCP). The chain has a supermarket group as the channel co-ordinator (chain captain), which owns the meat processing unit (cutting plant and distribution center) and controls most of the chain arrangements. The supermarket livestock agent is responsible for buying and selection of finished animals on the open market. The animals are sent to the abattoir and then to the supermarket meat processing unit, and finally the meat reaches the shelves of the supermarket shops.

The lamb chain is very similar to the beef chain. It produces Quality Mark lambs (standard set up by the New Zealand Beef and Lamb Marketing Bureau) for supermarket outlets in the South Island of New Zealand. The supermarket group is the channel coordinator (chain captain). This supermarket group employs a livestock agent who is responsible for the procurement of the finished animals in the open market. It also vertically integrates meat processing, chilling, warehousing, and the retail level of the chain.