

## **Supply Chain Performance Indicators for Australian Beef Industry: An Empirical Analysis**

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Preferred Stream: Technology, Quality and Operations Management

### Profile:

Ferry Jie is an Associate Lecturer at School of Management, Faculty of Business, University of Technology, Sydney and also a PhD student at the University of Sydney, Australia. His research project is concerned with Australian beef supply chain management. The project has been funded by the Peter Baillieu Memorial Agribusiness Grant.

His research interests are Operations Management, Supply Chain Management, Quality Management, Production Planning and Inventory Control and Operations Research.

He completed his bachelor and master degrees in Industrial Engineering. His bachelor thesis was on Production Planning and his master degree thesis was about Quality Function Deployment (QFD).

He has been teaching at two universities in Australia (UTS and USYD) since 2003.

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### **Abstract:**

*This research presents and analyses supply chain performance indicators for Australian beef producers, processors and retailers/wholesalers based on an empirical approach.*

*The survey results showed that:*

- *for producers, competitive advantage was significantly influenced by the supply chain performance components food quality, flexibility and responsiveness*
- *for processors, competitive advantage was significantly influenced by the supply chain performance components food quality and responsiveness*
- *at the retail/wholesale level, competitive advantage was significantly influenced by food quality, flexibility, responsiveness and efficiency*
- *a significant problem affecting the overall performance of the Australian beef supply chain was unskilled and inexperienced staff.*

*Various statistical tests confirmed the validity and reliability of the results.*

Keywords: supply chain performance indicators, food quality, flexibility, responsiveness, efficiency.

## INTRODUCTION

Beef supply chain management is the integration of beef producers, beef processors, retailers and end customers. The cattle move from feedlots/farms to processors who transform them into beef products and organise delivery into the hands of end customers. Smith (2001) indicates that this supply chain includes: seedstock generators, cow/calf producers, stockers/backgrounders, feedlot operators, packers, processors, supermarket operators and food-service providers. In this paper we analyse supply chain performance indicators for Australian beef producers, processors and retailers/wholesalers. The problem statements are:

- Do attributes such as flexibility, efficiency, food quality and responsiveness (Aramyan, 2006; Beamon, 1999; Gunasekaran, Patel, & McGaughey, 2004; S. Li, Rao, Ragu-Nathan T.S, & B, 2002; S. H. Li, 2002; Luning, Marcelis, & Jongen, 2002) influence Australian beef competitive advantage (price, quality, export sales growth and time to market)?
- What are the major difficulties arising when implementing supply chain management in the Australian beef industry? What kind of changes can be made to beef supply chains to enhance their performance?

An Australian beef supply chain framework (domestic and international marketing) is shown in Figure 1.

### **Stage 1: Breeding, backgrounding, fattening properties and feedlots**

This stage, cattle breeding and fattening, is the beginning section of the beef supply chain. There are around 76,600 beef enterprises in Australia (Australian Bureau of Statistics, 2005). They produced around 25 million head of cattle in 2005 with a gross value of production of around \$5.7 billion (Australian Bureau of Statistics, 2005; MLA, 2004). Additionally, around 65% of production is typically exported. The contribution of the feedlot sector is around 27% of total

beef production. There are 680 accredited feedlots in Australia, representing a total capacity of around 850,000 cattle (ALFA, 2002; Australian Bureau of Statistics, 2005; Dundon, 1994; MLA, 2003, 2004).

### **Stage 2: Processing**

This stage transforms the cattle into carcass and primal beef and veal products. The most valuable product from beef cattle production is meat. There are around 240 to 300 abattoirs in Australia (MLA, 2004). The number of operating abattoirs varies depending on seasonal weather conditions. An abattoir is the facility where cattle are processed into meat and other products such as offal and hides. About 25 large processors, located across Australia, process 61% of production (MLA, 2004). Bone out is done primarily at the abattoir where the animal was killed. There are many internal operations in the beef processing facility such as holding yards, slaughter, hide removal, removing internal organs, trimming, weighing, chilling, boning, meat inspection service, and packaging (MLA, 2004).

### **Stage 3: Beef wholesaling and retailing**

There are two lines of distribution in beef retailing. The first is the domestic market. After processing beef or veal, those products may be distributed to the wholesaler or broker. They then might go to the food services sector, butchers' shops or supermarkets such as Coles, Woolworths, BILO, IGA, and Franklins. Transportation is a key element at this stage of the domestic and international supply chain. Red meat is transported in refrigerated trucks, and the surface temperature of the hanging carcass must not go above 7°C. There are several guidelines for the product receipt such as no delays, safe and still fresh. The domestic beef market consumes about 30-35 percent of the processed beef and veal. Around 68 percent by weight of this is sold through supermarkets and retail butcher outlets, while 27 percent is marketed through the food service sector (92 percent of which is through commercial food service outlets and 8 percent is

distributed through institutional food service providers). The remaining 5 percent is marketed to the processing sector to be further transformed into other food products (MLA, 2004; Morgan, 2005).

#### **Stage 4: End customer**

The end products (beef or veal) from food services, butchers' shops and supermarkets go to the end customers who consume them. Beef is the most popular meat in Australia. Most customers in Australia consume beef or lamb as a main meal around three times a week. Australia has the fourth highest beef consumption level in the world at 36 kg/capita/year (MLA, 2004; Morgan, 2005).

### **CONCEPTUAL FRAMEWORK: SUPPLY CHAIN PERFORMANCE INDICATORS**

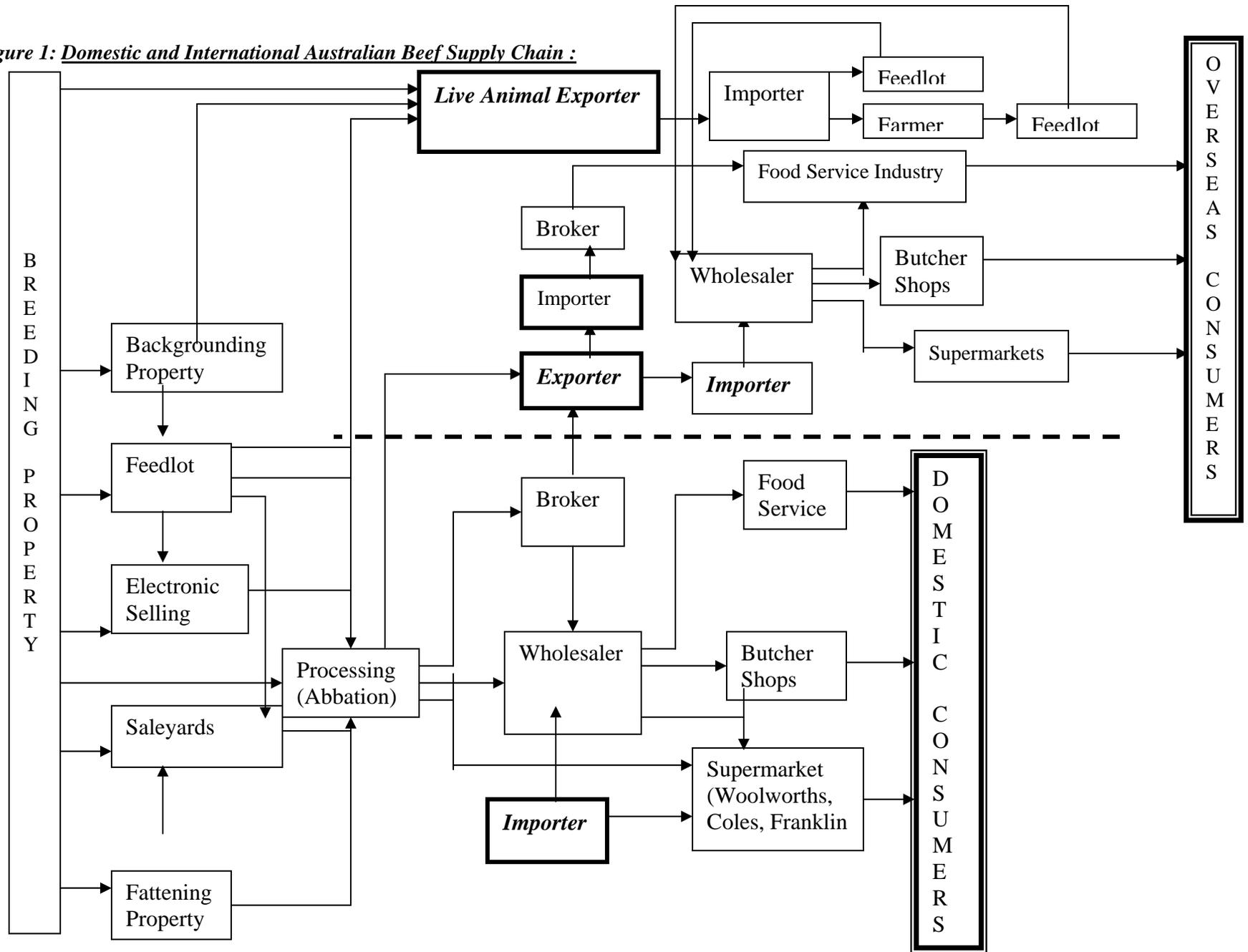
Four indicators were used to analyse Australian beef supply chain performance. They were *food quality, responsiveness, efficiency and flexibility* (Beamon 1999; Li 2002; Luning *et al.* 2002; Gunasekaran, *et al.* 2004; Aramyan *et al.* 2006).

#### **1. Supply chain performance – Food Quality**

Beef quality has many different definitions (Loxton, 2005) including:

- Quality refers to aspects of the carcass such as weight, fat cover and distribution, muscling/conformation and bruising.
- Quality refers to aspects of chiller assessment attributes such as meat colour, intermuscular fat colour and marbling.
- Quality refers to beef processors', wholesalers' & retailers' assessments such as primal cut shape, size, weight, success of vacuum packaging, amount of drip loss in vacuum bags, ultimate pH, meat colour and fat colour in the display case.

**Figure 1: Domestic and International Australian Beef Supply Chain :**



- Quality refers to the end consumers' assessments such as food safety, price, tenderness, visual attributes (i.e appearance, meat colour and fat colour, fat content (perceived marbling & external fat cover of meat), wholesomeness and nutrition.

## 2. Supply chain performance - Flexibility

Flexibility means the agility of a supply chain in responding to marketplace or customer demand changes to gain or maintain competitive advantage (SCOR, 2006). There are several types of flexibility:

- *Volume flexibility* is 'the ability to effectively increase or decrease aggregate production in response to customer demand' (Cleveland, Schroeder, & Anderson, 1989), p.103). Volume flexibility may require close coordination between a processor and its suppliers, especially in the face of increasing demand. Volume flexibility directly impacts on the performance of the supply chain by preventing out-of-stock conditions of products that are suddenly in high demand or by preventing high inventory levels (and obsolete stock).
- *Flexibility in dynamic operations*
- *Delivery flexibility* is the company's capability to adapt lead times to the customer requirements. An example of high delivery flexibility is just in time, when suppliers deliver the products to the customer at the right quantity, place and time

## 3. Supply chain performance - Responsiveness

Responsiveness is the velocity at which a supply chain provides products to the customer (SCOR 2006). Responsiveness indicators in the beef supply chain are customer response time, lead time, delivery time, customer returns, and order fill rate.

#### **4. Supply chain performance – Efficiency**

In this study efficiency consists of the six indicators farm cost/plant cost, inventory cost, waste cost, transportation cost, labour cost, and profit.

### **METHOD**

A supply chain management survey for Australian beef industry was conducted by distributing a mail questionnaire to beef producers, processors and retailers/wholesalers. The survey asked participants in the industry to express their views on various aspects of the supply chain, with focus being placed on the indicators discussed above. The effective response rate was 23%.

Using Cronbach's alpha (Cronbach, 1951), to test internal consistency, values of 0.6-0.87 were obtained. While 0.7 or above is desirable (Hair, 2006), 0.5-0.6 is sufficient (Nunnally, 1978).

In this project, the majority of items are based on established scales that have already been subjected to tests of content validity (Aramyan, 2006; Beamon, 1999; Gunasekaran et al., 2004; S. H. Li, 2002; Luning et al., 2002). In addition, the pre-test confirmed that a group of industry experts viewed the scales as acceptable.

Discriminant and convergent validity were assessed by using factor analysis. Again the results fell within the acceptable range and hence division into beef producing, processing and retailers/wholesalers was appropriate. Finally, stepwise multiple regression analysis was performed. Australian beef industry supply chain performance indicators (independent variables) were regressed on competitive advantage (dependent variable).



performance indicators. The current research project also found that several supply chain practices such as developing customer relationships, strategic supplier partnerships, information quality, information sharing and trust have a significant influence on those key performance indicators.

- Supply chain performance responsiveness and food quality have a significant influence on *processors'* competitive advantage. Beef processors should start with building core competencies that focus on customer requirements by having appropriate quality for beef and then delivering beef in a manner that results in high levels of customer satisfaction. Specific examples include quick response and responding professionally to customer returns. The current research found that trust which is an antecedent of cooperative behaviour has a significant influence on those key performance indicators. Trust is critical for any partnership or alliance to work. Trust enables beef enterprises to share valuable information, devote time and resources to understanding each other's businesses, and achieve results beyond what could have been done individually.
- Responsiveness, food quality, flexibility and efficiency have a significant influence on *retailers'/wholesalers'* competitive advantage. Beef retailers should understand and keep building partnerships with processors and end customers by providing good alliance experiences, good communication and information sharing. In addition, Collaborative Planning Forecasting Replenishment (CPFR) (Andraski & R.Ireland, 2003; Syncra Systems Inc, 2003) is a good approach for beef retailers to strengthen partnerships, provide analysis of sales and upstream and downstream order forecasts and use point of sales to improve forecast accuracy. Interestingly, the current research project found that strategic supplier partnerships were strongly correlated with the food quality performance indicator, and also that trust and

commitment had a strong correlation with responsiveness. Additionally, a lean approach may have good impact on efficiency, as this approach is focusing on customer value and the elimination of waste. In this, it is important to include all functions of the beef supply chain.

The results of the survey also indicated that the first concern when managing the supply chain in Australian beef enterprises is unskilled and inexperienced personnel (Mode = 4 – Significant Problem). Moreover, other problems (shipping error, shipping delay and quality problems, government policy, high inventory and variability of customer demand) do not get attention from respondents. This suggests that the current project should give them lower priority.

With the unskilled and inexperienced personnel problem, there are several suggestions for the beef industry to apply. First, they need to improve their general, specific and technical knowledge and also general, interpersonal and supportive managerial skills by providing training and short course programs. MINTRAC is an organisation in Australia established to provide training or professional development for meat industry personnel, for example, butchers, livestock managers, etc. Another strategy, which recommends providing direct encouragement and incentives to employers to address skills shortages, sets a challenge for business to increase commitment to training and for State and Federal governments to accelerate reform of vocational education and training (VET). Second, beef enterprises may try to apply outsourcing. This means that they can import labour or staff from overseas to supply skilled or experienced staff in the red meat industry. Hence, based on occupational lists in skilled migration, butchers are in demand in Australia.

## CONCLUSIONS AND FURTHER RECOMMENDATION

### Conclusions

A conceptual framework of Australian beef supply chain performance indicators was established and has been tested empirically. The survey results are:

- Food quality, flexibility and responsiveness have a significant influence on *producers'* competitive advantage.
- Supply chain performance responsiveness and food quality have a significant influence on *processors'* competitive advantage.
- Responsiveness, food quality, flexibility and efficiency have a significant influence on *retailers'/wholesalers'* competitive advantage.
- One significant problem for Australian beef supply chain performance was unskilled and inexperienced staff or personnel.

### Further Recommendation

1. As the conceptual framework of this research project has been tested empirically, the framework (integration of supply chain practice, supply chain performance indicators and competitive advantage) might potentially be useful for other red meat industries (such as sheep, lamb or kangaroo). Additionally, that framework might be a good idea also for other agricultural products (for instance, fresh vegetable produce, seafood, etc).
2. The red meat industry might apply one of the supply chain performance measures such as the balance scorecard (BSC), activity based costing (ABC) and supply chain operations reference (SCOR).

3. Further research needs to be done to delve more deeply and discover solutions for supply chain concerns (for instance government regulation and variable customer demand issues).

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