

Review of Published Chain Information System Research

7th International Conference on Chain Management in Agribusiness and the Food Industry,
Ede, The Netherlands, 31 May -2 June 2006

Christine E. Storer, Jacques H. Trienekens, Adrie J.M. Beulens and Mohammed A. Quaddus,
Muresk Institute, Curtin University of Technology, Perth Western Australia.

Abstract

This paper provides a review of the literature on chains and networks that examine inter-organisational information systems used to manage chains of organisations. Difficulty was found in finding out how organisations exchanged information to manage relationships with customers and suppliers in chains. Most research publications found were based on case studies and few looked at chains of three or more organisations. Substantial research over a greater time period was found on dyadic buyer-seller inter-organisational relationships (companies and either their customers or suppliers). Conclusions are made about how to describe inter-organisational information systems and suggestions for empirical chain research using comparative pairs for data collection and analysis.

Keywords: Literature review, Network studies, Dyadic studies, Comparative pairs

1 Introduction

The researchers' findings in previous studies that agribusiness organisations were not receiving timely indicators of changing customer requirements stimulated the interest to examine inter-organisational information systems used to manage chains of organisations. Of primary interest for the study was inter-organisational information management systems in chains. This paper will provide a review of the published research that was found in this area.

In reviewing previous research, a differentiation can be made based on the complexity of the system studied. Increasing degrees of complexity look at the information and communication systems of individuals, groups, organisations, inter-organisational dyadic relationships with buyers (customers) or sellers (suppliers), chains (supplier, focal firm and customer), networks (multiple suppliers and/or customers) and netchains (figure 1).

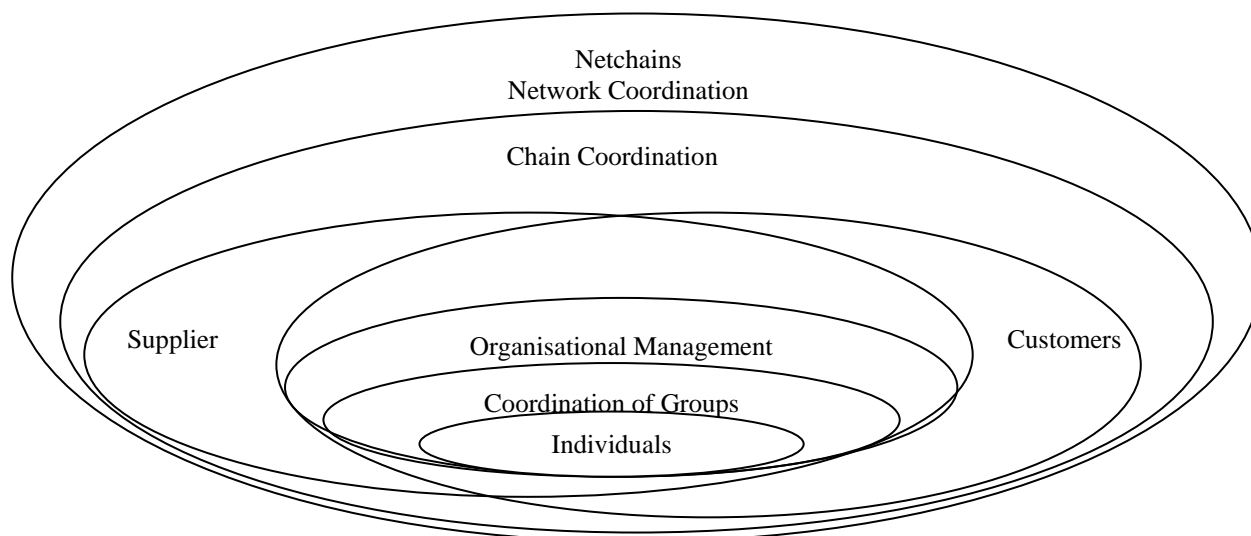


Figure 1 Complexity of Information Communication System Researched

It may be argued that the study of chains or networks of organisations is similar to groups within organisations in that the information processing is shared by several individuals who have to converge on similar interpretations and bridge disagreements and diversity. There is however, one major difference. Within organisations there is a superior person (owner, manager or chief executive officer) with legitimate power to decide which groups work together and to provide incentives and disciplines if objectives are not met. Unless there is a superior power through joint ownership, chain and network members do not have to work together long-term if their objectives are not mutually beneficial. Chains must operate under federated control by agreement between entities in the chain with cooperation based on negotiation, the acceptance of common policies and, most importantly, the establishment of trust (Siemieniuch et al. 1999). In the event of a dispute, there is no superior to decide the outcome unless an independent arbitrator is agreed upon. Even so, an arbitrator's decision may not be legally binding on both parties. Therefore, there may be differences in the way inter-organisational information systems are managed compared to organisational systems. The nature of the relationship will be important to provide capacity to resolve conflicts.

The aim of this paper is to determine how inter-organisational information systems operate to manage customers and suppliers in chains of organisations. Empirical research on networks will be reviewed first, followed by empirical research on chains, inter-organisational systems between two organisations (dyad with either customers or suppliers) and conclusions about the literature review.

1.1 Network Case Studies - Netchain Coordination & Inter-organisational Information Systems

Most network case studies found examined a single focal firm's view of their relationships with other organisations in their network (e.g. Anderson et al. 1994, Holmen and Pedersen 2001, Volkoff et al. 1999). Holmen & Pedersen (2001) studied the knowledge of a focal firm about its direct and indirect network of relationships based on key boundary staff informants. They did not study the customers through to the end consumer nor the nature of the inter-organisational information system. Volkoff et al. (1999) use a case study of a network to examine the information technology systems needed to support horizontal collaborative networks and concluded that social and professional networks and inter-organisational development teams were important.

Two network case studies found collected data from multiple organisations (Cadilhon et al. 2003, O'Reilly et al. 2003). Cadilhon et al. (2003) examined a case study of the food marketing network system in Ho Chi Minh City to study its evolution over time. They collected data from multiple stakeholders vertically in the chain and horizontally in the network (wholesalers, hauliers, traditional retailers, modern food marketing sector managers, input manufacturers, government officials and academics). Details of information systems were not reported.

O'Reilly et al. (2003) examined a case study of the 44 Parma Ham producers in the Italian consortium network to determine reasons for participation in the consortium. The most important consortium activities were: regulatory measures (eg certificate of origin), regulatory information and analysis, promotion, quality control systems and market information.

According to Claro, Zylbersztajn & Omta (2004 p7) "Networks have been investigated in relation to alliances (e.g. Gulati 1998), organizational management (e.g. Kenis & Knoke 2002), organizational learning (e.g. Kogut 2000), strategy formulation (e.g. Jarillo 1988), preferred suppliers (e.g. Dyer 1996), international relationships (e.g. Hakansson & Johanson 1993) and marketing channels (e.g. Antia & Frazier 2001). Others have investigated networks as webs of firms connected by information communication technology and forming virtual organizations (e.g. Ahuja & Carley 1999)."

In summary, the only insight provided by the network studies into how inter-organisational information systems worked was that information may be exchanged horizontally between producers about regulations, promotions, quality and markets (O'Reilly et al. 2003). They did not provide much insight into how inter-organisational information systems worked in vertical chains of organisations nor what affected them. Empirical research on chains found is discussed next.

1.2 Empirical Chain Studies - Chain Coordination & Inter-organisational Information Systems

Most empirical research on chains found were based on case studies. Five empirical studies were found that collected data from chains of organisations (focal firm, a customer and a supplier) in multiple chains (Clare et al. 2002, Hardman et al. 2002, Lehtinen and Torkko 2004, Matanda and Schroder 2002, Spekman et al. 1998). Most of the studies found had been published in the last four years. First empirical studies of multiple chains are reviewed followed by research on chain case studies and conclusions on chain research.

1.1 Empirical Multiple Chain Studies

The most comprehensive multiple chain research found was conducted by Spekman et al. (1998) who studied 22 chains. In other studies it is not made clear how many separate chains were studied and their studies may possibly be better described as netchain case studies.

Spekman et al. (1998) conducted a chain study of 161 respondents in different functional departments (operations, procurement, materials management or marketing) and levels (suppliers, focal company, customers) in 22 supply chains. While they looked into relationships, performance and information flows, they did not examine the nature of the information system in detail. They concluded that trust and commitment affected customer satisfaction. They suggest collaborating in relationships that are both strategically important and complex to manage. In addition, while information systems and technology facilitate capabilities for cooperation, all in the chain must share similar goals and objectives for it to succeed. This can be difficult as they found that buyers tended to be reluctant players in cooperation as they were far more skeptical about the benefits afforded through such close integration. Buyers appeared to be less sensitive to information that linked levels of the supply chain in general, and appeared to be far less concerned about information that was directly linked to end-consumer considerations. Buyers tended to focus more on the cost reduction aspects of supply chain management, and viewed securing a reliable source of supply, reduced lead time, and lower costs as key drivers of supply chain management. Conversely, sellers tended to highlight revenue enhancement and see profits, strategic market position, and customer satisfaction as prime drives for supply chain management.

Kurnia & Johnston (2003) surveyed 42 Australian grocery manufacturers, brokers, wholesalers, distributors and retailers to examine efficient consumer response (ECR) adoption. The survey was supported by more detailed case studies of three manufacturers and two retailers operating in six supply chains that analysed interactions with trading partners. Kurnia & Johnston (2003) found that Australian retailers were leading manufacturers in ECR adoption, experiencing more benefits and having more power than manufacturers. In addition, there was a lack of trust and cooperation between manufacturers and retailers.

Hardman et al. (2002) surveyed 37 producers, 5 packers and 7 exporters in a South African apple chain to find that higher levels of trust led to more cooperation in terms of joint problem solving and improved communication. Higher levels of joint problem solving and communication, in turn, encouraged producers to commit more human resources to working with packers and exporters to find ways of making the chain more competitive. They concluded there was greater cooperation on

delivery scheduling and quality control. In addition, more cooperation was needed in production planning and delivery scheduling.

Clare, et al. (2002) surveyed 375 red meat producers, 32 livestock buyers and 13 meat processor companies in New Zealand to investigate gaps in perceptions between each set of dyad organisations in the chain. Producers rated livestock buyers significantly higher than meat processors on all relationship measures including information sharing (depth and intensity) and information quality (timeliness, accuracy, adequacy, conciseness and credibility). Similarly livestock buyers rated producers significantly higher than meat processors on almost all relationship measures (information quality was not significantly different). The meat processors rated livestock buyers more highly than producers (except symmetry) but the only significant differences were in terms of trust, commitment, information sharing and coordination of work. When their perceptions of each other were compared, there were no significant differences in terms of trust, commitment or interdependence. However there were some significant differences. Producers perceived information quality was higher when compared to livestock buyers and meat processors. However, producers perceived less information was shared when compared to livestock buyers.

Matanda & Schroder (2002) surveyed 655 horticultural farmers, processors, wholesalers and retailers in Zimbabwe. They included sharing of market information in their measure of innovation to find that: innovation was positively related to technical and marketing efficiency as well as cost and waste reduction. Innovation was positively associated with market turbulence (product substitutability and sales forecast accuracy) and negatively associated with environmental volatility (changing consumer preferences and quality of competing products).

Lehtinen & Torkko (2004) surveyed 13 small food firms, 24 small food manufacturers and 2 retailers in Norway to determine what outsourcing was being practiced and the reasons for doing so.

In *summary*, none of the multiple chain studies looked in detail at how inter-organisational information systems worked and what affected them. However what can be gleaned from the multiple chain studies was that types of information exchanged included mentions of: costs, supply security, lead time, revenue, and customer satisfaction by Spekman et al. (1998); production plans, problem solving, delivery schedules, and quality by Hardman et al. (2002); and market information by Matanda & Schroder (2002). In addition, information may be measured in terms of information sharing (depth and intensity) and information quality (timeliness, accuracy, adequacy, conciseness and credibility) (Clare et al. 2002).

Other issues raised by the studies were that variables that may be associated with information systems could be shared goals and objectives (Spekman et al. 1998), trust (Hardman et al. 2002), commitment (Hardman et al. 2002), and strategic importance and relationship complexity (Spekman et al. 1998). From the work of Spekman et al. (1998) it may be expected that the reasons for coordination may be different between buyers and sellers and this may influence the nature of information exchanged (Buyers focus on costs, supply security and lead time; Sellers focus on revenue and customer satisfaction). Similarly, Clare, et al. (2002) found that there were significant differences in perceptions of information sharing and information quality through the chain. With few empirical studies to support these findings from the literature researching multiple chains of organisations, chain case study research is reviewed next.

1.2 Empirical Chain Case Studies

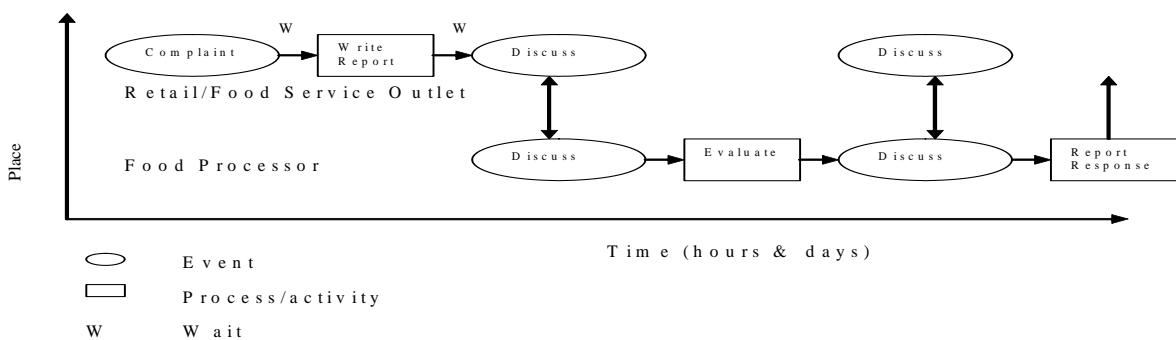
Empirical research on chains found was mostly based on case studies. The chain case studies that provided most insights into information systems used to manage chains were those analysing the performance of chains of organisations such as case studies analysed by Trienekens (1999) and Van

der Vorst (2000) as well as the Supply Chain Operations Reference (SCOR) model chain performance metrics developed by the Supply Chain Council (www.supply-chain.org).

Trienekens (1999) examined four chain case studies in designing a research framework to describe the process perspective on chains. The first case study of four food companies and three retailers was analysed to improve efficiency of assortment, promotion and replenishment. The second case study of the strategic planning and forecasting decision structure in a processed food products chain was analysed to improve efficiency through lower integral chain stock, less stock outs and fresher products. In the third chain case study of a food processor, retail distribution centre and retail outlet, ordering processes were analysed to improve their effectiveness. The fourth case examined a marketing organisation’s role in fresh produce assembly and distribution and the resulting order decoupling point.

The nature of information flows between organisations in the four cases included: market information, promotions, sales, forecast supply and demand, strategic plans, deliveries (announced and delays), loading, routing, pick process (unforeseen shortages), order process data (deviations in orders), stock availability, production plans, damage, theft, and performance feedback. Perhaps the most insights were gained in the way processes were documented within and between organisations using event process chain models and GRAI grids. The flow of information was documented not only between the two organisations but also through the receiving organisation and on to the next organisation in the chain e.g. from a customer, through an organisation and on to a supplier.

Figure 2 Event Process Chain Model for a complaint



Source: Adapted from Trienekens (1999)

Event process chain maps record where events, processes or activities occur (place – organisation in chain), the time taken (hours or days) and any significant average delay (wait) (Figure 2). They can be used to map the flow of products and information through chains of organisations with specific detail provided of processes involved to highlight delay problems and bottlenecks.

GRAI grids analyse coordination of decisions and related information flows between decision levels and organisations in chains. They can be used to document organisations, functional departments and the hierarchical levels involved in exchanging information in chains. For example Figure 3 shows how a strategic plan made by retailer executives was used in the retailers decision making as well as how the details were conveyed to secondary processor executives and management and through to primary processor executives.

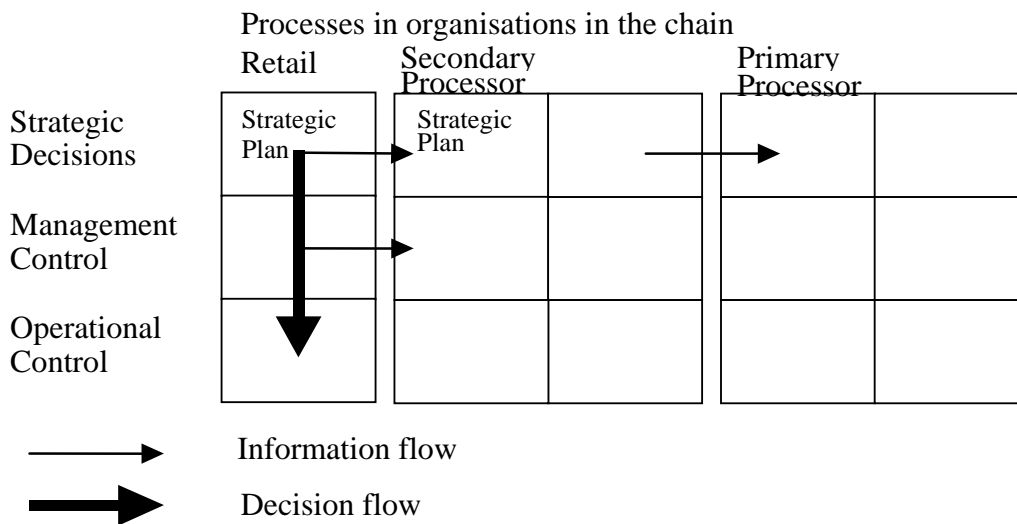


Figure 3 *GRAI Grid for strategic planning*
 Source: Adapted from Trienekens (1999)

Van der Vorst (2000) also used chain mapping and modelling tools to analyse three Dutch food chain case studies to devise a research method for the generation, modelling and evaluation of supply chain scenarios. The aim was to improve supply chain performance. The first chain case study included fruit & vegetable growers, auctions, an exporter and retailers. The second chain case study comprised a salad producer and a retailer (retail distribution centre supplying 100 retail outlets). The third chain case study was of two dessert suppliers, a cheese producers and a retailer (retail distribution centre and 25 retail outlets). Maps were used to describe chain processes including event process chain models (to analyse timing of processes) and organisation description language (inputs, transformation and outputs of business processes). While the focus of the process maps were on analysing day-to-day business operations of ordering and deliveries, information flows between organisations for management mentioned in the three cases included: promotion plans, forecast supply and demand, delivery reliability, incomplete orders, inventory levels, out of stocks, product freshness & quality, performance indicators. Inter-organisational information communication media used included EDI, telephone, fax and paper. Information was assessed in terms of: reliability, accuracy, availability, timeliness (up-to-date), and applicability (relevancy). Factors that affected information flows and performance included the character and experience of individuals as well as uncertainty of: supply, demand (changing consumer preferences), distribution, process (yield variations, quality variation, perishability, losses, shortages, errors), planning and control.

Several other chain case studies were found that analysed chain performance and analysed the movement of products to eliminate waste and develop a 'lean' chain. Primarily this has been based on analysing the motor vehicle manufacturing industries (e.g. Daniels 1999, Francis 1998, Womack and Jones 1996, Womack et al. 1990) although there have been some case studies in the food industry e.g. ketchup manufacturing industry in Finland (Lehtinen and Torkko 2002), a UK food retailer distribution system (Samuel and Hines 1998), and a UK lamb chain (Simons et al. 2003). Process activity maps were used to document the flow of materials and associated information as well as the time taken to identify where value is added and where there is waste (similar to Trienekens's (1999) event process chain maps with more detail). Production and sales were graphed to show variations in inventory levels to determine if costs could be saved by reducing inventory levels through improved information flows (reduce the 'bullwhip effect').

Other chain case studies found looked at issues other than chain performance. They looked at: features of chain partnerships (Supply Chain Partnerships Program 2000); transportation information flows (Kanflo 1998); chain marketing strategies (Lindgreen et al. 2004); organisational

behaviour (Hornibrook and Fearne 2001); the role of inter-organisational electronic collaboration tools on innovativeness (Lefebvre et al. 2003); strategies adopted following market deregulation (Issar et al. 2004) and a number of studies analysed chain quality and traceability (Champion and Fearne 2002, Goldsmith et al. 2002, Jones and Zobel 2002, Kola et al. 2002, Korneliussen and Grønhaug 2003).

In *summary*, while none of the empirical chain studies found looked in detail at how inter-organisational information management systems operated, some useful comments were raised. What can be gleaned from the empirical chain case studies is that types of information exchanged between organisations included mentions of: promotions, sales, strategic plans, deliveries (announced and delays), loading, routing, pick process (unforeseen shortages), order process data (deviations in orders or incomplete orders), delivery reliability, stock availability (inventory levels and out of stocks), production plans, damage, theft, and performance feedback (Trienekens 1999, Van der Vorst 2000); delivery, computer assisted design, replenishment, direct procurement, and product shortages, capacity planning and business strategy (Lefebvre et al. 2003); market information (Issar et al. 2004, Lindgreen et al. 2004, Trienekens 1999, Van der Vorst 2000); forecast supply and demand (Lefebvre et al. 2003, Simons et al. 2003, Trienekens 1999, Van der Vorst 2000); planning performance measurement (Simons et al. 2003, Van der Vorst 2000); tracking and tracing information (Lefebvre et al. 2003, Van Dorp 2004); product freshness & quality (Champion and Fearne 2002, Goldsmith et al. 2002, Jones and Zobel 2002, Kola et al. 2002, Korneliussen and Grønhaug 2003, Van der Vorst 2000). Performance metrics have been summarised as relating to delivery reliability (delivery performance, fill rate, order fulfilment lead time and perfect order fulfilment), costs (total logistics management cost, value-added employee productivity and warranty costs), and assets (cost-to-cash cycle time, inventory days of supply and asset turns) (Huang et al. 2004) or alternatively as relating to customer service, financial, productivity and quality indicators (Bowersox and Closs 1996).

Other aspects of inter-organisational information systems could be gleaned including: communication media used to exchange this information (Lindgreen et al. 2004, Van der Vorst 2000), people involved in the information exchange (Lindgreen et al. 2004, Supply Chain Partnerships Program 2000) as well as frequency and formality of communications (Supply Chain Partnerships Program 2000). Quality of information could be assessed in terms of: reliability, accuracy, availability, timeliness (up-to-date), and applicability (relevancy) (Van der Vorst 2000). Diagrams can be used to map out or model processes and information flows through the chain (e.g. Simons et al. 2003, Trienekens 1999, Van der Vorst 2000, Van Dorp et al. 2002). Other issues raised by the studies were the variables that may affect inter-organisational information systems

2 Chain Research Conclusions

In conclusion, difficulty was found in finding out how organisations exchanged information to manage relationships with customers and suppliers in chains (inter-organisational information management systems). There seems to be a lack of empirical testing of research on chains of organisations on how inter-organisational information management systems work and what affects them. Most research publications found were based on case studies and few looked at chains of three or more organisations. Those that looked at multiple chains did not look in detail at information systems. Reliance on cases studies can be problematic as it may be difficult to generalize the results outside the case study. Cavaye & Cragg (1995) also found the focus of inter-organisational research had been on describing case studies rather than developing theory and empirical testing of theoretical models. Similarly, Cohen & Mallik (1997) in a review of the state of knowledge and practice in supply chain management found that in terms of practice, what had been written about supply chain management was conceptual and somewhat impractical, inspirational but sometimes vague, or too company specific and therefore hard to apply to other situations (Ganeshan et al. 1999).

According to Barratt (2004 p36) “Lee & Whang (2000) highlight the almost total lack of empirical research into information sharing in the supply chain. Apart from Barret & Konsynski’s (1982) study of information sharing in the general context, Lee & Whang (2000) suggest that most work has been conceptual in its nature, and has not focused on information sharing in the supply chain context.” He goes on to argue that many of the collaboration elements of “culture, trust, information exchange and supply chain wide performance measures have been to a large extent ignored due to their complexity, and deserve significant attention individually in terms of further research. Further research is also required to develop a deep understanding of the relationship between these elements of collaboration” (Barratt 2004 p40). Bechtel & Jayaram (1997), in a review of supply chain management literature, suggested further research is required on how different members of the chain receive and use customer information and the best practices for diffusion of information through the chain.

While not the focus of this paper, in researching this topic substantial research over a greater time period was found on dyadic buyer-seller inter-organisational relationships (companies and either their customers or suppliers). Most frequently dyadic relationships have been studied only from the perspective of one of the organisations (e.g. Anderson and Narus 1990, Batt and Rexha 1999, Bensaou 1992, Bensaou 1997, Bensaou 1999, Bensaou and Venkatraman 1995, Bensaou and Venkatraman 1996, Doney and Cannon 1997, Gundlach et al. 1995, Kumar et al. 1992, Leuthesser and Kohli 1995, Mohr et al. 1996, Mohr and Sohi 1995, Morgan and Hunt 1994, Venkatraman and Zaheer 1990). Fewer studies were found that studied both organisations in the dyad (e.g. Anderson and Weitz 1992, Anderson and Narus 1990, Clare et al. 2002, Claro et al. 2004, Ellram 1995, Forker et al. 1999, Ganesan 1994, Heather 2001, Karalis and Vlachos 2004, Korneliussen and Grønhaug 2003, Lindgreen 2001, McDermott et al. 2004, Miller 2002, Sethuraman et al. 1988, Sparling and van Duren 2002, Sweeney and Webb 2002, Vlosky et al. 1997, Wilson and Vlosky 1998).

Aside from the reservations about case studies, the chain case studies were particularly rich in passing comments about the on the types of information that may be exchanged to manage chains as well as how it may be exchanged and what may affect these chain information systems.

2.1 Types of Information

The types of information have been categorised to summarise the wide range of terms used.

Problem resolution - problem solving (Hardman et al. 2002)

Product and Performance Feedback generally - planning performance measurement (Simons et al. 2003, Van der Vorst 2000), assets (cost-to-cash cycle time, inventory days of supply and asset turns) (Huang et al. 2004), productivity (Bowersox and Closs 1996), performance feedback (Trienekens 1999, Van der Vorst 2000).

Product quality –product freshness & quality (Bowersox and Closs 1996, Champion and Fearn 2002, Goldsmith et al. 2002, Hardman et al. 2002, Jones and Zobel 2002, Kola et al. 2002, Korneliussen and Grønhaug 2003, Van der Vorst 2000), damage (Trienekens 1999), tracking and tracing information (Lefebvre et al. 2003, Van Dorp 2004).

On-time delivery – delivery schedules (Hardman et al. 2002), delivery reliability - delivery performance and fill rate (Huang et al. 2004), customer service (Bowersox and Closs 1996), delivery, replenishment and direct procurement (Lefebvre et al. 2003), deliveries (announced and delays), loading and routing (Trienekens 1999), delivery reliability (Van der Vorst 2000).

Completeness of orders – perfect order fulfilment (Huang et al. 2004), product shortages (Lefebvre et al. 2003), customer service (Bowersox and Closs 1996), pick process (unforeseen shortages) and order process data (deviations in orders) (Trienekens 1999), incomplete orders and out of stocks (Van der Vorst 2000).

Flexibility to change orders – lead time (Spekman et al. 1998), order fulfilment lead time (Huang et al. 2004), customer service (Bowersox and Closs 1996), stock availability (Trienekens 1999), inventory levels (Van der Vorst 2000).

Prices, Costs & Profitability - market information (Issar et al. 2004, Lindgreen et al. 2004, Matanda and Schroder 2002, Trienekens 1999, Van der Vorst 2000), costs (total logistics management cost, value-added employee productivity and warranty costs) (Huang et al. 2004), costs (Spekman et al. 1998), revenue (Spekman et al. 1998), financial (Bowersox and Closs 1996).

Supply and Demand Forecasts - forecast supply and demand (Lefebvre et al. 2003, Simons et al. 2003, Trienekens 1999, Van der Vorst 2000); production plans (Hardman et al. 2002, Trienekens 1999); capacity planning (Lefebvre et al. 2003).

Promotions - promotions (Trienekens 1999), promotion plans (Van der Vorst 2000)

Opportunities & Threats – strategic plans (Trienekens 1999)

2.2 Other Aspects of Inter-organisational Information Systems

In terms of other aspects of inter-organisational information systems, communication media used to exchange this information included: EDI, telephone, fax and paper (Van der Vorst 2000) and face-to-face discussions (Lindgreen et al. 2004). People involved in the information exchange included managers from across functions and levels in the firm (Lindgreen et al. 2004). Points of inter-organisational contact increased and organisational boundaries became fuzzy (Supply Chain Partnerships Program 2000). Communications become faster and more informal, and knowledge diffusion increased (Supply Chain Partnerships Program 2000). Information could be assessed in terms of: reliability, accuracy, availability, timeliness (up-to-date), and applicability (relevancy) (Van der Vorst 2000). Information may be measured in terms of information sharing (depth and intensity) and information quality (timeliness, accuracy, adequacy, conciseness and credibility) (Clare et al. 2002).

Most chain analysis studies used diagrams to map out or model processes and information flows through the chain (e.g. Simons et al. 2003, Trienekens 1999, Van der Vorst 2000, Van Dorp et al. 2002). Such chain mapping tools used in analysing chains should be suitable to document information flows in chains (e.g. event process chain models and GRAI grids).

2.3 Factors that may affect Inter-organisational Information Systems

Other issues raised qualitatively by the studies were that variables that may affect inter-organisational information systems could be: years experience in the relationship (Supply Chain Partnerships Program 2000); commitment (Hardman et al. 2002); strategic importance and relationship complexity (Spekman et al. 1998); shared goals and objectives (Spekman et al. 1998); process innovations such as new product development and category management (Issar et al. 2004, Lefebvre et al. 2003); responsiveness (Simons et al. 2003); relational innovations such as building trust, improved loyalty and enriched quality of relations (Lefebvre et al. 2003); trust (Hardman et al. 2002, Lindgreen et al. 2004, Simons et al. 2003, Supply Chain Partnerships Program 2000); character and experience of individuals (Van der Vorst 2000); effect on other markets (Kola et al. 2002); chain role and activities (Korneliusson and Grønhaug 2003); USA government farmer income support policies (Jones and Zobel 2002); opportunity of agents to shirk responsibilities, perceived risk and uncertainty (Hornibrook and Fearn 2001); as well as uncertainty of: supply, demand (changing consumer preferences), distribution, process (yield variations, quality variation, perishability, losses, shortages, errors), planning and control (Van der Vorst 2000).

From the work of Spekman et al. (1998) it may be expected that the reasons for coordination may be different between buyers and sellers and this may influence the nature of information exchanged

(Buyers - costs, supply security and lead time; Sellers - revenue and customer satisfaction). Similarly, Clare, et al. (2002) found that there were significant differences in perceptions of information sharing and information quality through the chain.

2.4 Preliminary Theoretical Model

With a wide range of variables identified as being able to be used to describe an Inter-organisational Information Systems and many factors that may affect the way the system works, a preliminary theoretical model of Inter-Organisational Information Systems has been suggested to pull them together (Figure 4).

The description of the Inter-Organisational Information Systems can be based around whether information is exchanged about: problem resolution; performance feedback; product quality; on time delivery; completeness of orders; flexibility to change orders; prices, costs and profitability; forecast supply and demand; promotions; and opportunities and threats. For each type of information shared, details can be sought about: the exchange frequency; communication media used; formality of the process; key people and departments involved in the exchanges and the direction information flows. The resulting systems can be mapped using chain mapping tools such as event process chain models and GRAI grids. In addition an overall satisfaction with the information system can be measured.

Business Environment Moderating Factors:

- Product & market characteristics (uncertainty/predictability)
 - Relationship dependency/power
 - Relationship & industry experience

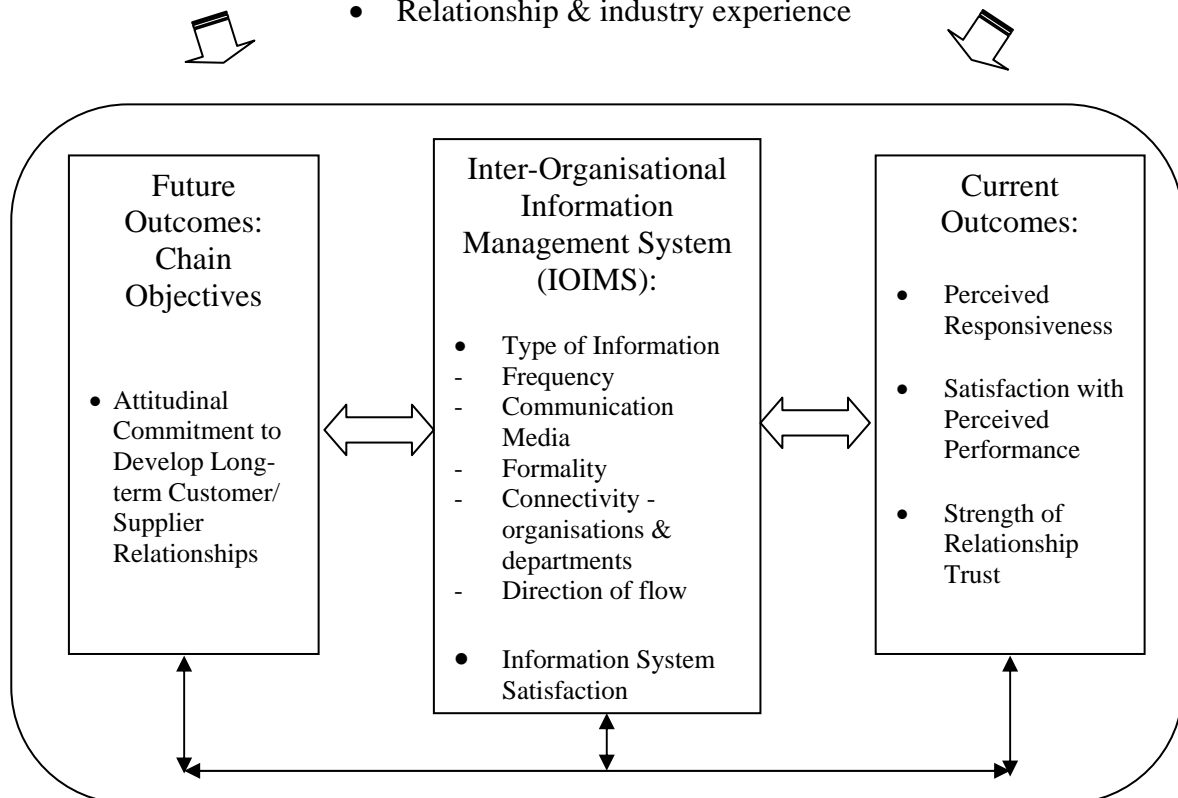


Figure 4 Model of Inter-Organisational Information Systems

It is suggested that (attitudinal) commitment to develop long-term customer/supplier relationships (future outcomes) would be related to the nature of the inter-organisational information system adopted in the chain which, in turn, would be related to perceived performance, responsiveness and

trust in the chain (current outcomes). Further, the model argues the results would be moderated by environmental factors such as product and market uncertainty, relationship dependency and power, as well as experience in the relationship and in the industry.

2.5 Future Research

Future research is needed to test the proposed model of Inter-Organisational Information Systems. With the reservations of relying on case studies and qualitative comments made, the challenge in future research is to conduct chain and network research that can be generalised more widely. If the traditional case study methods are used, this may be done by comparative studies across different industry sectors, countries or regions.

An alternative quantitative chain data collection approach is to use comparative pairs analysis (Storer et al. 2004). Using comparative pairs analysis it is argued that chains of organisations can be analysed by collecting data from a focal firm about upstream suppliers and downstream customers (3. in Figure 5). By comparing pairs of respondents within the focal firm, the differences between customers and suppliers can be analysed. In addition, it is suggested that by asking each respondent to discuss two third party organisations, differences in responses can be highlighted and explained during the data collection process. Because negotiations are only needed to interview boundary spanning staff (those who interact with customers and suppliers) in one organisation, greater sample sizes can be achieved and results more generalisable to wider contexts of interest.

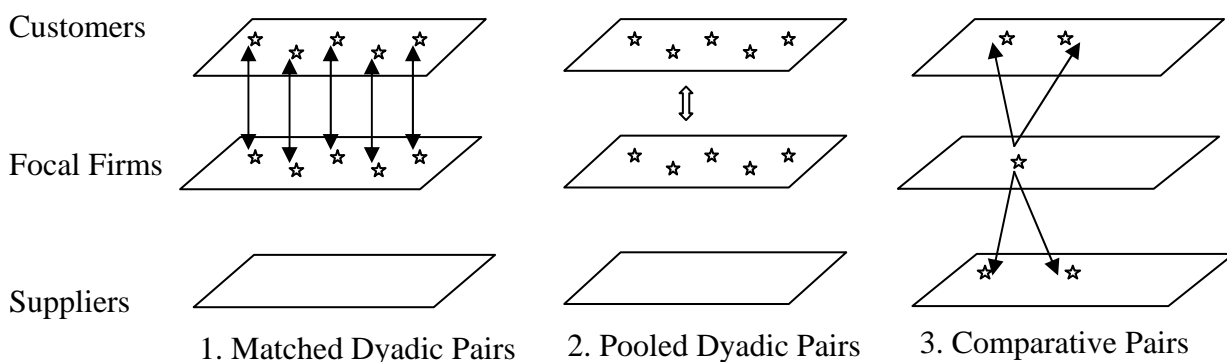


Figure 5: Alternative Units of Data Collection for IOIS Chain Research

Comparative pairs analysis overcomes problems of using matched dyadic pairs (1. in Figure 5) in getting small sample sizes when one of the pair fails to participate in the research. It also overcomes the problems of using pooled dyadic pairs (2. in Figure 5) where you may not necessarily get data from those organisations that interact with each other.

Further research has subsequently been carried out to test the model and trial the comparative pairs analysis technique. Copies of papers about this can be obtained from the principle author.

References:

- Anderson, E. and Weitz, B. A. (1992) "The Use of Pledges to Build and Sustain Commitment in Distribution Channels," *Journal of Marketing Research*, Vol. 29, Iss. 1 February, pp. 18-34.
- Anderson, J. C., Håkansson, H. and Johanson, J. (1994) "Dyadic Business Relationships within a Business Network Context," *Journal of Marketing*, Vol. 58, Iss. 4, pp. 1-15.
- Anderson, J. C. and Narus, J. (1990) "A Model of Distributor Firm and Manufacturer Firm Working Partnerships," *Journal of Marketing*, Vol. 54, Iss. January, pp. 42-58.
- Barratt, M. A. (2004) "Understanding the Meaning of Collaboration in the Supply Chain," *Supply Chain Management: An International Journal*, Vol. 9, Iss. 1, pp. 30-42.

- Barret, S. S. and Konsynski, B. (1982) "Inter-organizational Information Sharing Systems," *MIS Quarterly*, Vol. 6, Iss. 3 Fall.
- Batt, P. J. and Rexha, N. (1999) "Building Trust in Agribusiness Supply Chains: A Conceptual Model of Buyer-Seller Relationships in the Seed Potato Industry in Asia," *Journal of International Food and Agribusiness Marketing*, Vol. 11, Iss. 1, pp. 1-17.
- Bechtel, C. and Jayaram, J. (1997) "Supply Chain Management: A Strategic Perspective," *The International Journal of Logistics Management*, Vol. 8, Iss. 1, pp. 15-34.
- Bensaou, M. (1992) *Interorganizational Coordination: Structure, Process, Information Technology: An Empirical Study of Buyer-Seller Relationships in the US and Japanese Auto Industries*, PhD Thesis, Massachusetts Institute of Technology, Cambridge, MA, USA.
- Bensaou, M. (1997) "Interorganizational Cooperation: The Role of Information Technology. An Empirical Comparison of U.S. and Japanese Supplier Relations," *Information Systems Research*, Vol. 8, Iss. 2, pp. 107-124.
- Bensaou, M. (1999) "Portfolios of Buyer-Supplier Relationships," *Sloan Management Review*, Vol. 40, Iss. 4 Summer, pp. 35-.
- Bensaou, M. and Venkatraman, N. (1995) "Configurations of Inter-Organizational Relationships: A Comparison Between U.S. and Japanese Auto-makers," *Management Science*, Vol. 41, Iss. 9 September, pp. 1471-1492.
- Bensaou, M. and Venkatraman, N. (1996) "Inter-Organizational Relationships and Information Technology: A Conceptual Synthesis and a Research Framework," *European Journal of Information Systems*, Iss. Special issue on Information Technology and Interorganizational Networks September, pp. 84-91.
- Bowersox, D. J. and Closs, D. J. (1996) *Logistical Management: The Integrated Supply Chain Process*, McGraw-Hill, New York, NY, USA.
- Cadilhon, J.-J., Fearn, A. P., Moustier, P. and Poole, N. D. (2003) "Modelling Vegetable Marketing Systems in South East Asia: Phenomenological Insights from Vietnam," *Supply Chain Management: An International Journal*, Vol. 8, Iss. 5, pp. 427-441.
- Cavaye, A. L. M. and Cragg, P. B. (1995) "Factors Contributing to the Success of Customer-oriented Interorganizational Systems," *The Journal of Strategic Information Systems*, Vol. 4, Iss. 1 March, pp. 13-31.
- Champion, S. C. and Fearn, A. P. (2002) "The Communication Vacuum in the Wool Supply Chain - Insights From an Exploratory Study of the Australian Apparel Wool Textile Industry", In *5th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Paradoxes in Food Chains and Networks*, Ed. Trienekens, J. H., Omta, S.W.F. Onno, Wageningen Academic Publishers, Noordwijk, the Netherlands, pp. 919-927, 6-8 June 2002
- Clare, B., Shadbolt, N. and Reid, J. (2002) "Supply Base Relationships in the New Zealand Red Meat Industry: A Case Study", In *5th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Paradoxes in Food Chains and Networks*, Ed. Trienekens, J. H., Omta, S.W.F. Onno, Wageningen Academic Publishers, Noordwijk, the Netherlands, pp. 805-816, 6-8 June 2002
- Claro, D. P., Zylbersztajn, D. and Omta, S. W. F. O. (2004) "How to Manage a Long-term Buyer-seller Relationship Successfully? The Impact of Network Information on Long-term Buyer-seller Relationships in the Dutch Potted Plant and Flower Industry," *Chain and Network Science*, Vol. 4, Iss. 1, pp. 7-24.
- Cohen, M. A. and Mallik, S. (1997) "Global Supply Chains: Research and Applications," *Production and Operations Management*, Vol. 6, pp. 193-210.
- Daniels, B. (1999) "Integration of the Supply Chain for Total Through-Cost Reduction," *Total Quality Management*, Vol. 10, Iss. 4-5 Special Issue, pp. S481-S490 July.
- Doney, P. M. and Cannon, J. P. (1997) "An Examination of the Nature of Trust in Buyer-Seller Relationships," *Journal of Marketing*, Vol. 61, Iss. 2 April, pp. 35-51.

- Dyer, J. H. (1996) "Specialized Supplier Networks as a Source of Competitive Advantage: Evidence from the Auto Industry," *Strategic Management Journal*, Vol. 17, Iss. 4, pp. 271-291.
- Ellram, L. M. (1995) "Partnering Pitfalls and Success Factors," *International Journal of Purchasing and Materials Management*, Vol. Spring.
- Forker, L. B., Ruch, W. A. and Hershauer, J. C. (1999) "Examining Supplier Improvement Efforts from Both Sides," *Journal of Supply Chain Management*, Vol. 35, Iss. 3, pp. 40-50.
- Francis, M. (1998) "Lean Information and Supply Chain Effectiveness," *International Journal of Logistics: Research and Applications*, Vol. 1, Iss. 1, pp. 93-108.
- Ganesan, S. (1994) "Determinants of Long-Term Orientation in Buyer-Seller Relationships," *Journal of Marketing*, Vol. 58, Iss. 2 April, pp. 1-19.
- Ganeshan, R., Jack, E., Magazine, M. J. and Stephens, P. (1999) "A Taxonomic Review of Supply Chain Management Research," In *Quantitative Models for Supply Chain Management*, Eds. Tayur, S., Ganeshan, R. and Magazine, M., Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 841-879.
- Goldsmith, P., Salvador, A., Knipe, D. and Kendall, E. (2002) "Structural Change or Logical Incrementalism? Turbulence in the Global Meat System Chain and Network Science," *Chain and Network Science*, Vol. 2, Iss. 2, pp. 101-115.
- Gundlach, G. T., Achrol, R. S. and Mentzer, J. T. (1995) "The Structure of Commitment in Exchange," *Journal of Marketing*, Vol. 59, Iss. 1 January, pp. 78-92.
- Hardman, P. A., Darroch, M. A. G. and Ortmann, G. F. (2002) "Improving Cooperation to Make the South African Fresh Apple Export Value Chain More Competitive", In *5th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Paradoxes in Food Chains and Networks*, Ed. Trienekens, J. H., Omta, S.W.F. Onno, Wageningen Academic Publishers, Noordwijk, the Netherlands, pp. 434-443, 6-8 June 2002
- Heather, B. (2001) *Buyer Seller Relations: Retail Supplier Relations in the Horticultural Industry*, Honours Thesis, Muresk Institute of Agriculture, Curtin University of Technology, Bentley, Western Australia.
- Holmen, E. and Pedersen, A. (2001) "Knowledge and Ignorance of Connections Between Relationships", In *17th Annual IMP (Industrial Marketing & Purchasing) Conference*, 9-11 September, Oslo, Norway
- Hornibrook, S. A. and Fearn, A. P. (2001) "Managing Perceived Risks: A Multi-tier Case Study of a UK Retail Beef Supply Chain," *Chain and Network Science*, Vol. 1, Iss. 2, pp. 87-100.
- Huang, S. H., Sheoran, S. K. and Wang, G. (2004) "A Review and Analysis of Supply Chain Operations Reference (SCOR) Model," *Supply Chain Management: An International Journal*, Vol. 9, Iss. 1, pp. 23-29.
- Issar, G. S., Cowan, R. T., Woods, E. J. and Wegener, M. (2004) "Dynamics of Australian Dairy-Food Supply Chain: Strategic Options for Participants in a Deregulated Environment", In *6th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Dynamics in Chains and Networks*, Eds. Bremmers, H. J., Omata, S. W. F. O., Trienekens, J. H. and Wubben, E., Wageningen Academic Publishers, Ede, The Netherlands, pp. 458-464, 27-28 May 2004
- Jones, E. and Zobel, C. (2002) "A Decision Support System for Value-Added Production in the Mid-Atlantic Wheat Industry", In *5th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Paradoxes in Food Chains and Networks*, Ed. Trienekens, J. H., Omta, S.W.F. Onno, Wageningen Academic Publishers, Noordwijk, the Netherlands, pp. 870-882, 6-8 June 2002
- Kanflo, T. (1998) *Information in Transportation Chains*, Licentiate, Department of Transport and Logistics, Chalmers University of Technology, Goteborg, Sweden, Available [online]: http://www.trp.chalmers.se/Forskning/licentiatuppsatser/Lic_T.Kanflo.html.

- Karalis, V. and Vlachos, I. P. (2004) "Supplier-Retailer Collaboration in Food Networks: A Typology and Examination of Moderating Factors", In *6th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Dynamics in Chains and Networks*, Eds. Bremmers, H. J., Omata, S. W. F. O., Trienekens, J. H. and Wubben, E., Wageningen Academic Publishers, Ede, The Netherlands, pp. 280-287, 27-28 May 2004
- Kola, J., Latvala, T. and Vertanen, A. (2002) "Quality Information in the Beef Supply Chain", In *5th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Paradoxes in Food Chains and Networks*, Ed. Trienekens, J. H., Omta, S.W.F. Onno, Wageningen Academic Publishers, Noordwijk, the Netherlands, pp. 928-934, 6-8 June 2002
- Kornieliussen, T. and Grønhaug, K. (2003) "Quality Perceptions in International Distribution: An Empirical Investigation in a Complete Distribution Channel," *Supply Chain Management: An International Journal*, Vol. 8, Iss. 5, pp. 467-475.
- Kumar, N., Stern, L. W. and Achrol, R. S. (1992) "Assessing Reseller Performance from the Perspective of the Supplier," *Journal of Marketing Research*, Vol. 29, Iss. 2, pp. 238-253.
- Kurnia, S. and Johnston, R. B. (2003) "Adoption of Efficient Consumer Response: Key Issues and Challenges in Australia," *Supply Chain Management: An International Journal*, Vol. 8, Iss. 3, pp. 251-262.
- Lee, H. L. and Whang, S. (2000) "Information Sharing in a Supply Chain," *International Journal of Technology Management*, Vol. 20, Iss. 3-4, pp. 373-387.
- Lefebvre, E., Cassivi, L., Lefebvre, L., Léger, P.-M. and Hadaya, P. (2003) "Supply Chain Management, Electronic Collaboration Tools and Organizational Innovativeness," *Chain and Network Science*, Vol. 3, Iss. 2, pp. 81-94.
- Lehtinen, U. and Torkko, M. (2002) "A Contract Manufacturer goes Lean: How to Analyse and Develop Value Streams", In *5th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Paradoxes in Food Chains and Networks*, Ed. Trienekens, J. H., Omta, S.W.F. Onno, Wageningen Academic Publishers, Noordwijk, the Netherlands, pp. 859-869, 6-8 June 2002
- Lehtinen, U. and Torkko, M. (2004) "Outsourcing as a Challenge for Food Firms", In *6th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Dynamics in Chains and Networks*, Eds. Bremmers, H. J., Omata, S. W. F. O., Trienekens, J. H. and Wubben, E., Wageningen Academic Publishers, Ede, The Netherlands, pp. 65-71, 27-28 May 2004
- Leuthesser, L. and Kohli, A. K. (1995) "Rational Behavior in Business Markets: Implications for Relationship Management," *Journal of Business Research*, Vol. 34, Iss. 3, pp. 221-233.
- Lindgreen, A. (2001) "In Search of Relationship Quality, Customer Retention and Shareholder Value: Findings from an Exploratory, Qualitative Multiple Case Study," *Chain and Network Science*, Vol. 1, Iss. 1, pp. 49-63.
- Lindgreen, A., Trienekens, J. H. and Vellinga, K. (2004) "Contemporary Marketing Practice: A Case Study of the Dutch Pork Supply Chain", In *6th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Dynamics in Chains and Networks*, Eds. Bremmers, H. J., Omata, S. W. F. O., Trienekens, J. H. and Wubben, E., Wageningen Academic Publishers, Ede, The Netherlands, pp. 273-279, 27-28 May 2004
- Matanda, M. and Schroder, B. (2002) "Environmental Factors, Supply Chain Capabilities and Business Performance in Horticultural Marketing Channels," *Chain and Network Science*, Vol. 2, Iss. 1, pp. 47-60.
- McDermott, A., Lovatt, S. J. and Koslow, S. (2004) "Supply Chain Performance Measures for Producers and Processors of Premium Beef Cuts", In *6th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Dynamics in Chains and*

- Networks*, Eds. Bremmers, H. J., Omata, S. W. F. O., Trienekens, J. H. and Wubben, E., Wageningen Academic Publishers, Ede, The Netherlands, pp. 369-378, 27-28 May 2004
- Miller, J. (2002) *Long-Term Buyer-Seller Relationships in the Western Australian Nursery Industry*, Honours thesis, Muresk Institute of Technology, Curtin University of Technology, Bentley, WA.
- Mohr, J. J., Fisher, R. J. and Nevin, J. R. (1996) "Collaborative Communication in Interfirm Relationships: Moderating Effects of Integration and Control," *Journal of Marketing*, Vol. 60, Iss. 3 July, pp. 103-115.
- Mohr, J. J. and Sohi, R. S. (1995) "Communication Flows in Distribution Channels: Impact on Assessments of Communication Quality and Satisfaction," *Journal of Retailing*, Vol. 71, Iss. 4, pp. 393-416.
- Morgan, R. M. and Hunt, S. D. (1994) "The Commitment-Trust Theory of Relationship Marketing," *Journal of Marketing*, Vol. 58, Iss. 3 July, pp. 20-38.
- O'Reilly, S., Haines, M. and Arfini, F. (2003) "Food SME Networks: Process and Governance - The Case of Parma Ham," *Chain and Network Science*, Vol. 3, Iss. 1, pp. 21-32.
- Samuel, D. and Hines, P. (1998) "Designing a Supply Chain Process: A Food Distribution Case", In *1998 Logistics Research Network Conference*, Institute of Logistics, Cranfield University, United Kingdom, 10-11 September 1998
- Sethuraman, R., Anderson, J. C. and Narus, J. A. (1988) "Partnership Advantage and Its Determinants in Distributor and Manufacturer Working Relationships," *Journal of Business Research*, Vol. 17, Iss. 4, pp. 327-347.
- Siemieniuch, C. E., Waddell, F. N. and Sinclair, M. A. (1999) "The Role of "Partnership" in Supply Chain Management for Fast-Moving Consumer Goods: A Case Study," *International Journal of Logistics: Research Applications*, Vol. 2, Iss. 1, pp. 87-101.
- Simons, D., Francis, M., Bourlakis, M. and Fearn, A. P. (2003) "Identifying the Determinants of Value in the U.K. Red Meat Industry: A Value Chain Analysis Approach," *Chain and Network Science*, Vol. 3, Iss. 2, pp. 109-121.
- Sparling, D. and van Duren, E. (2002) "Strategic Alliances in the Canadian Biotechnology Sector", In *5th International Conference on Chain and Network Management in Agribusiness and the Food Industry: Paradoxes in Food Chains and Networks*, Ed. Trienekens, J. H., Omta, S.W.F. Onno, Wageningen Academic Publishers, Noordwijk, the Netherlands, pp. 729-741, 6-8 June 2002
- Spekman, R. E., Kamauff, J. W. J. and Myhr, N. (1998) "An Empirical Investigation Into Supply Chain Management: A Perspective on Partnerships," *International Journal of Physical Distribution & Logistics Management*, Vol. 28, Iss. 8, pp. 630-650.
- Storer, C. E., Soutar, G. N. and Quaddus, M. A. (2004) "Comparative Pairs Analysis for Inter-organisational Information Systems (IOIS) Research," In *Inter-Organizational Information Systems in the Internet Age*, Ed. Eom, S., Idea Group Publishing, pp. 297-327 Ch XII.
- Supply Chain Partnerships Program (2000) *Improving Your Supply Chain Partnership Shelf-Help Manual 7: Features of Supply Chains*, Vol. 2000, Department of Industry, Science and Resources, Available [online]: www.business.gov.au/supplychain.
- Sweeney, J. C. and Webb, D. (2002) "Relationship Benefits: An Exploration of Buyer-Supplier Dyads," *Journal of Relationship Marketing*, Vol. 1, Iss. 2, pp. 77-91.
- Trienekens, J. (1999) *Management of Processes in Chains: A Research Framework*, PhD Thesis, Wageningen University, Wageningen, The Netherlands.
- Van der Vorst, J. G. A. J. (2000) *Effective Food Supply Chains: Generating, Modelling and Evaluating Supply Chain Scenarios*, PhD Thesis, Management Studies Group, Wageningen University, Wageningen.
- Van Dorp, C. A. (2004) *Reference-data Modelling for Tracking and Tracing*, PhD thesis, Department of Computer Science, Wageningen University, Wageningen, The Netherlands.
- Van Dorp, C. A., Beulens, A. J. M. and Beers, G. (2002) "Gozinto Graphs for Tracking and Tracing: An Approach for Information Systems", In *5th International Conference on Chain*

and Network Management in Agribusiness and the Food Industry: Paradoxes in Food Chains and Networks, Ed. Trienekens, J. H., Omta, S.W.F. Onno, Wageningen Academic Publishers, Noordwijk, the Netherlands, pp. 883-893, 6-8 June 2002

- Venkatraman, N. and Zaheer, A. (1990) "Electronic Integration and Strategic Advantage: A Quasi-Experimental Study in the Insurance Industry," *Information Systems Research*, Vol. 1, Iss. 4, pp. 377-393.
- Vlosky, R. P., Wilson, D. T. and Vlosky, R. B. (1997) "Closing the Interorganizational Information Systems Relationship Satisfaction Gap," *Journal of Marketing Practice: Applied Marketing Science*, Vol. 3, Iss. 3, pp. 75-87.
- Volkoff, O., Chan, Y. E. and Newson, E. F. P. (1999) "Leading the development and implementation of collaborative interorganizational systems," *Information and Management*, Vol. 35, Iss. 2 February, pp. 63-76.
- Wilson, D. T. and Vlosky, R. P. (1998) "Interorganizational Information System Technology and Buyer-seller Relationships," *Journal of Business and Industrial Marketing*, Vol. 13, Iss. 3, pp. 215-228.
- Womack, J. and Jones, D. (1996) *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*, Simon & Schuster, New York, USA.
- Womack, J. P., Jones, D. T. and Roos, D. (1990) *The Machine That Changed the World: Based on the Massachusetts Institute of Technology 5-million Dollar 5-Year Study of the Future of the Automobile*, Rawson Associates, New York.