"The Impact of Electronically-enabled Supply Chains on Channel Relationships and Firm Performance"

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Declaration

I, Faraz Bidar declare that the thesis:

- Contains no material which has been accepted for the award to the candidate of any other degree or diploma, except where due reference is made in the text of the thesis

- To the best of my knowledge contains no material previously published or written by another person except where due reference is made in the text of the thesis; and

- Where the work is based on joint research or publications, discloses the relative contributions of the respective or authors.

Signature: Date:

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Abstract

The widespread adoption of information technologies (IT) characterising the recent competitive advantage scenario has been of great interest to researchers and practitioners. An important management question today is whether the anticipated economic benefits of information technology are being realised. There have been contradictory findings in the literature regarding its impact on firms' productivity. While the debate known as the "IT productivity" paradox still endures, empirical studies have not shown consistent results to clarify how IT offers benefits to the owning firms. Due to information technology having become an integral component in supply chain management, it is important to examine its impact on today's organisations. While the information technology literature is mixed regarding the direct benefits of information communication technologies on performance and improving competitive advantage, the impact of business to business enabling technologies on supply chain practices remains largely an unexplored area of research. Therefore this study seeks to assess the business value of IT in supply chain relationships and firm performance. The primary research questions are whether and how IT capabilities can create competitive advantage and enhance firm performance through supply chain relationships (channel capabilities).

Drawing on the resource based theory of the firm and transaction cost economic theory, this study developed and tested a model that proposes supply chain channel capabilities (information sharing, supply chain coordination and supply chain responsiveness) as higher organisational capabilities which mediate the effects of a firm's IT capabilities on its market and financial performances. This research study is particularly focused on industries associated with innovative products (based on Fisher's model (1997)) for which supply chain responsiveness is important. A quantitative approach for data collection and analysis is used. Descriptive and analytical (structural equation modelling) tools were employed to test both the measurement and structural models. This research study's main contribution lies in bridging a research gap by developing and empirically testing a model of IT capabilities that measures how IT can improve the effectiveness of firms' supply chain channel capabilities and can create competitive advantage and enhanced firm performance. The model includes the dimensions that build the higher order resource of IT capabilities such as electronic integration, human IT resources and IT complementary organisational resources.

The “IT productivity” paradox observed in various studies has been attributed to variation in methods and measures, and this study offers an additional explanation: i.e. ignoring IT complementary organisational resources (including IT integration strategy, CEO commitment and customer orientation) in business value of IT on supply chain relationships. The findings of this study reveal that a firm’s inter-organisational information sharing mediates the influence of IT capabilities on firm performance. However, they do not support the direct relationships between IT and supply chain coordination, and consequently the direct relationships between supply chain coordination and firm performance. These findings reveal the complexity of inter-organisational coordination, underscoring the importance for companies to promote supply chain coordination and invest in information technologies that facilitate it. The findings also reveal that improvement in supply chain channel capabilities through IT enables the company to learn and respond to market changes better and quicker than other supply chains (competitors). Practitioners can benefit from the results of this study in terms of the ramifications for investment decisions as well as to benchmark where they stand with their IT in terms of potential for value creation, business support and improving their supply chain management practices.

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Chapter One

Introduction

1.1 Background of the study

Traditionally, supply chain management (SCM) has been a melting pot of a range of disciplines, with influences from logistics and transportation, operations management and materials and distribution management, marketing, as well as purchasing and information technology (IT) (Giunipero, Hokker, Joseph-Matthews, Yoon & Brudvig 2008). Supply chain management can be considered as both an emergent field of practice and an emerging academic domain. Neither perspective is fully mature but each has significant promise. The future progress of each will be enhanced and in fact is ultimately dependent upon the other (Cousins, Lawson & Squire 2006). It has now been at least two decades since initial interest in the supply chain management domain was generated by the practitioner community, and over that time there has been an exponential growth in supply chain management themed studies in the academic press. Several factors are responsible for this increased interest such as the competitive pressures of a global marketplace, potential application of e-business technologies to streamline supply chain management processes, rising costs and shifting power to customers (Giunipero et al. 2008; Kinra & Kotzab 2008).

It is argued that competition is no longer merely between one company competing with another company, but between an entire supply chain competing with another supply chain (Christopher & Towill 2000). For a supply chain to compete effectively as a unit, the partner companies involved require to share information and coordinate their activities. This becomes more complex as the number of supply chain partners increase, and the issue with corporate boundaries naturally limits the flow of information, especially the tacit or latent information flow that generally arises out of frequent, unstructured and unrestricted communication. While the cost of any single communication delay may seem small, the overall value lost is significant. In addition, poor coordination generally leads to a mismatch in supply and demand known as the bullwhip effect. Hence, it leads to increases in the costs of stock-outs, expediting (due to insufficient inventory) and transhipment, as well as markdown, sale preparation and advertising, disposal and obsolescence (Horvath 2001). Low capacity

utilisation, long customer lead times, poor order fulfilment rates, poor quality and poor customer service are other costs of a lack of good coordination (Ramdas & Spekman 2000).

The development of information technologies provides better information sharing among supply chain members which is vital for close coordination (Lee 2000). This implies that information provides linkages that can be used to orchestrate all activities across the supply chain. The visibility of information to all supply chain members can overcome problems associated with communication, inventory costs, customer service and utilisation of capacity (Croom 2005; Disney & Towill 2003). Additionally, as the competition between supply chains grows more intense and widespread as a result of inevitable global competition, IT utilisation has changed its role from back office and operational support to strategic imperative. Firms have started to utilise IT to directly influence the processes comprising the value chain (Turban, Leidner, Mclean & Wetherbe 2008; Williams 1997).

In Australia, the business environment has changed rapidly in the last few decades. As a result of factors such as globalisation and removal by the Australian government of protectionist policies, the private sector now has to compete locally and internationally against aggressive global companies (Ramaseshan 1997, Mollenkopf & Dapiran 1999, 2005). To survive in such a dynamic competitive environment, organisations have to continually innovate. This involves developing an organisational form which can rapidly respond to, and take advantage of, the interdependence of modern organisations. One of the key drivers of Australia's strong economic growth and innovation is information and communications technology. According to a survey by the Economist Intelligence Unit, Australia ranked ninth out of 69 countries in terms of e-readiness in 2007 (DFAT 2010).

Technology has had a significant impact on Australian logistics and supply chain operations (McMullan 1996). This has occurred in many areas such as in the order fulfilment process, improved communication and information-handling methods and advances in the associated facilities required to make this happen. EDI (electronic data interchange), voice synthesiser and video text, for example, facilitate the receipt of an order; paperless picking warehouses using RF (radio frequency) and barcodes facilitate the picking of the order; and new transport equipment such as B-doubles scheduled and monitored by on-board computers facilitate the delivery of the order (Gilmour, Driva & Hunt 1995). At the same time, recently established

global information networks intend to support the integration between supply chain partners. The global data synchronisation network (GDSN), established by GS1 (formerly EAN-European Article Numbering Association-www.GS1.org) with the support of leading industry forums (Global Commerce Initiative (GCI), Efficient Consumer Response (ECR)), can also empower supply chain practice among Australian companies and improve their competitive advantage globally (Henderson, Kelly & Beaumont 2003; Power 2005).

It is argued that value in a supply chain is generated by lowering the firm's or partner's cost of sourcing or sales or increasing the service level (Faisal, Banwet & Shankar 2007). In order to achieve this, information technology can be used which is designed to manage complex information flows within or between firms (Biehl 2005). Therefore, in the 21st century more emphasis has been placed on integration within and between firms in the processes of information technology, mainly due to the Internet playing the role of a key enabler (Kirchmer 2004). The growth of virtual supply chains is a result of the use of IT to share information between buyers and sellers (Yusuf, Gunasekaran, Adeleye & Sivayoganathan 2004). Hence, supply chains can be considered as an IT enabled inter-organisational configuration, where the coordination of logistics processes among firms is crucial for good performance (Lewis & Talalayevsky 2004).

Increasingly, IT is used to facilitate internal coordination within a firm and enhance external integration with external parties (e.g. supply chain partners) and also to enhance decision making among members of the supply chain. This phenomenon is evident in the increased usage of information technologies and systems for integration purposes; for example, information systems infrastructure (e.g. data communication tools, network connection, standard data structure and unified coding standards), information systems software (e.g. enterprise-wide information system such as SAP and Oracle) and information systems applications (e.g. centralised database management systems, electronic data interchange (EDI) and web-based or Internet-based information systems). Although the advances in information technologies are considered a main driver of supply chain integration, the best way to deploy these technologies and to coordinate supply chain-wide activities is still being researched (Gangopadhyay & Huang 2004).

1.2 What is supply chain management?

1.2.1 Definition of supply chain (SC)

Several definitions of supply chain have been proposed. These are diverse according to the people involved, processes and goals comprised in the definition. Christopher, Lowson and Peck (2004) defined the supply chain as a connected series of organisations concerned with different processes and value activities including planning and controlling of raw materials, components and finished products from suppliers to the final customer. Frazelle (2001) explains that a supply chain is a network of enterprises, individuals, facilities and information/materials handling systems that connect our supplier's supplier to our customer's customer. According to Beamon (1999) a SC is an integrated process wherein raw materials are manufactured into final products, then delivered to customers via distribution, retail or both. The SC is a means for a set of independent firms jointly optimising their resources to take advantage of the market place (Porter 1998).

Lee and Billington (1993) identified three types of flows in a SC: information flow, product (material) flow and financial flow. Likewise, Christopher (1999) indirectly determines an indication of a "movement" by using the phrase "through upstream and downstream linkages". The Institute of Logistics and Transport (1998) recommends that these three flows have a direct impact on the configuration (entities, activities and purpose) of a supply chain. Examples of these three flows are listed in table 1.1.

Table 1.1: Three main flows of supply chain management

Type of flow	Examples
Information Flow	Forecasts, order transmissions and delivery status report
Product Flow	Movement of products from suppliers to customers and reverse flows via product returns, servicing, recycling and disposal
Financial Flow	Credit card information, credit terms, payment schedules, consignment and title ownership arrangement

Source: Institute of Logistics and Transport (1998)

1.2.2 Definition of supply chain management (SCM)

According to Lambert, Cooper and Pagh (1998), one of the most significant changes in the paradigm of modern business management is related to the strategic importance of supply chain management (SCM); as the economy changes and competition becomes more global, it is no longer company vs. company but supply chain vs. supply chain. Companies are looking for competitive capabilities that enable them to exceed customers' expectations and enhance market and financial performance (Hayes & Pisano 1994; Lado, Boyd & Wright 1992). Despite the importance of some particular supply chain activities (e.g. transportation and warehousing) in cost control, SCM was long overlooked as a potential area for achieving sustainable competitive advantage (Fawcett & Clinton 1997). Lately, however, its role has shifted from an emphasis on passive cost control, to a proactive role in shaping competitiveness and profitability (Holcomb 1994). Senior managers have identified that building effective supply chains contribute opportunities to create sustainable competitive advantage (Cooper, Lambert & Pagh 1997; Higginson & Alam 1997). The advantages are important due to their impact on competitive dimensions such as price competition, improved processes, reduced redundancies, lower inventory levels, better quality, reduced lead time and demand uncertainties, improved customer service levels and market responsiveness, and better access to target market segments (Fisher 1997; Mentzer, DeWitt, Keebler, Min, Nix, Smith, & Zacharia 2001; Tracey, Lim & Vonderembse 2005).

In order to gain these benefits, there is consequently a need for companies to manage not only their own organisation but also the relationships to other companies in the same supply chain (Croxton, Garcia-Dastugue, Lambert & Rogers 2001). Ideally, improvement of the supply chain is achieved through effective management, improved communication and integration (Angerhofer & Angelides 2006). Similarly, in order to implement SCM, it is essential to initiate coordination across the organisational boundaries, which involves the integration of processes and functions across the supply chain. Additional necessities that are often mentioned are shared information among the supply chain members as well as improved supply chain visibility (Christopher & Ryals 1999; Cooper, Lambert & Pagh 1997). An early example of information sharing was the belief that if organizations could more readily share information then this would eliminate demand amplification (Forrester 1958).

Latest developments in SCM determine that firms are allocating large investments to develop their SCs (Closs, Swink & Nair 2005; McIvor & Humphreys 2004). In addition, SCM and other similar terms, such as value chain management, network sourcing, value stream management, supply chain synchronisation and supply pipeline management, have become subjects of considerable interest to academics, consultants and business management (Croom, Romano & Giannakis 2000; Hines, Rich & Hittmeyer 1998; Lamming & Hampson 1996).

SCM has received much attention since the early 1980s, yet conceptually it is not particularly well understood, and many authors have highlighted the necessity of clear definitional constructs and conceptual frameworks. Therefore, various definitions of it have been offered in recent years, as the concept has gained popularity. However, SCM is still a complex phenomenon without a commonly accepted definition or implementation framework. Out of 100 randomly selected SCM articles, content analysed by Burgess, Singh and Koroglu (2006), 12 posited unique definitions, 21 referred to existing definitions, 9 used slightly modified versions of existing definitions, and 58 left SCM undefined. Stock, Boyer & Harmon (2010) identified three major themes associated with SCM through a qualitative analysis of 166 unique definitions of SCM published in literature (1- activities, 2- benefits, 3- constituents/ components). Beyond the definitional morass that seems to plague SCM research, multiple frameworks also have been proposed. The most popular supply chain management frameworks are the Supply Chain Operations Reference (SCOR) model and the Global Supply Chain Forum (GSCF) (Lambert, Cooper & Pagh 1998; Lockamy & McCormack 2004). The lack of definitions, standards and frameworks may explain the contradiction between the significant amount of hype regarding the potential of supply chain management, and the factual representation. The potentially beneficial results, as stated in many articles by academics and in promotional material by consulting firms, do not seem to translate into evidence as presented in empirically based academic articles (Lockamy & McCormack 2004). Some example of SCM definitions are provided in table 1.2.

Table 1.2: A sample of definitions of supply chain management

Authors	Definition
(Simchi-Levi & Kaminsky 2003)	Supply chain management is a set of approaches utilised to effectively integrate suppliers, manufacturers, warehouses and stores, so that merchandise is produced and distributed at the right quantities, to the right locations and at the right time, in order to minimise system wide costs while satisfying service level requirements.
(Mentzer et al. 2001)	The systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purpose of improving the long-term performance of the individual companies and supply chain as whole.
(Chopra & Meindl 2001)	Supply chain management includes a set of approaches and practices to effectively integrate suppliers, manufacturers, distributors and customers for improving the long-term performance of the individual firms and the supply chain as a whole in a cohesive and high performing business model.
(Tan, Kannan & Ghosh 1999)	The simultaneous integration of customer requirements, internal processes and upstream supplier performance.
(Cooper, Lambert & Pagh 1997)	Supply chain management is the integration of business processes from end user through original suppliers that provides products, services and information that add value for customers.
(Stevens 1989)	The objective of managing the supply chain is to synchronise the requirement of the customer with the flow of materials from suppliers in order to affect a balance between what are often seen as conflicting goals of high customer service, low inventory management and low unit cost.

1.3 The organisational scope of SCM

The organisational scope of SCM is related to the number of supply chain parties involved. There are two major views in literature related to this. The first argues that SCM covers all parties from point of origin to point of consumption, while the second perspective argues that there should be a minimum requirement of three parties to be involved. However, over the years, the views about the number of involved organisations in SCM have changed. In earlier articles, most authors may have believed that the scope covers all companies involved (Houlihan 1985; Jones & Riley 1985) or that SCM encompasses “the entire channel and not just a few channel pairs” (Cooper & Ellram 1993). Nevertheless, it appears the organisational scope of the supply chain is getting narrowed in recent years. One of the reasons can be the increasing efforts and attention in the literature and by companies to realise and implement

SCM, and that a company perspective therefore is often taken instead of a supply chain perspective. Early studies have indicated very high expectations on what can be called SCM and so it is almost impossible to see such SCM in reality (Cooper, Ellram, Gardner & Hanks 1997; Stadtler 2008).

The understanding of the organisational scope is directly related to the way one defines and interprets a SC. Some researchers distinguish between "traditional commodity chain" and a supply chain, whereas other researchers do not. Cooper and Ellram (1993) and Cooper et al. (1997) whose perspectives are closely related to the first view, argue that not all companies are automatically involved in a SC. Cooper and Ellram (1993) determine some of the main aspects that distinguish a traditional commodity chain from a SC (see table 1.3).

Table 1.3: Aspects that distinguish a supply chain from traditional commodity chain

Element	Traditional	Supply chain
Inventory management approach	Independent efforts	Joint reduction in channel inventories
Channel leadership	Not needed	Needed for coordination focus
Time horizon	Short term	Long term
Amount of information sharing and monitoring	Limited to needs of current transaction	As required for planning and monitoring processes
Speed of operations, information and inventory flows	"Warehouse" orientation (storage, safety stock) interrupted by barriers to flow; localised to channel pair	"DC" orientation (inventory velocity) interconnecting flows; JIT, Quick Response across the channel
Joint planning	Transaction-based	Ongoing
Compability of corporate philosophies	Not relevant	Compatible at least for key relationships
Breadth of supplier base	Large to increase competition and spread risk	Small to increase coordination
Amount of sharing of risks and rewards	Each on its own	Risks and rewards shared over the long term
Total cost approach	Minimise firm costs	Channel-wide cost efficiencies
Amount of coordination of multiple levels in the channel	Single contract for transaction between channel pair	Multiple contracts between levels in firms and levels of channel

Source: Cooper & Ellram (1993)

The second view is that all companies are always involved in a SC. For example, Mentzer et al. (2001) suggest that in order to use the term SC, there is no requirement to have more than a set of companies structured in a way that one supplies to another which in turn supplies to a third and so on. Thus, no distinction between commodity chain and supply chain is made.

Lambert and Cooper (2000) argue that all companies participate in SCs all the time, reaching from raw material to the end customer. However, how and which part or links of the SC should be managed is another issue to be considered in SCM. They have also suggested that distinguishing among primary and supporting members of the SC can be helpful for simplifying and clarifying the organisational scope of SCM. They defined primary members as "those autonomous companies or strategic business units who carry out value-adding activities (operational and/or managerial) in the business processes designed to produce a specific output for a particular customer or market". Supporting members are defined as "companies that simply provide resources, knowledge, utilities, or assets for the primary members of the supply chain". This categorisation can be compared with the concept of three degrees of "supply chain complexity" along with direct supply chain, extended supply chain and ultimate supply chain identified by Mentzer et al. (2001). When a focal company is involved with a supplier and a customer it is called a direct SC. This view with three independent units is considered as a minimum to SCM. In the extended supply chain, the supplier's supplier and the customer's customer are also included. Lastly, in the ultimate SC, all companies involved in the upstream and downstream flows of goods, services, finance and information from the very first raw material supplier to the very end customer are included (Mentzer et al. 2001). In the ultimate SC, carriers and third party logistics companies are also included in the organisational scope of SCM (Tan 2001).

Hence, in recent years the inter-organisational scope of SCM seems to consider a minimum of three organisationally independent parties, which in its simplest structure could be a supplier, a third party logistics provider and a supplier's customer. In the case of considering only primary members of a SC (which is the case in this thesis), a SC could consist of a focal company and its customer and supplier.

1.4 Significance of the study

Despite acknowledgment among academics and practitioners that IT is now crucial to compete in many businesses (Hulland & Wade 2004), or the fact that some research indicates a strong relationship between IT and improvements in business performance, IT's strategic role as a source for competitive advantage is under scrutiny (Carr 2003; Sircar, Turnbow & Bordoloi 2000). In addition, there is no clear evidence for a direct relation between investment in IT, competitive advantage and firm performance (Kohli & Grover 2008). Hence, while top managers are very keen to know the effects of IT investments on firms' performance and competitive advantage, the answers to these questions are unclear among practitioners and academics. Therefore, the important question for researchers remains: how does IT contribute to competitive advantage and firm performance?

It is argued that although the commercial IT infrastructure in most companies is nearing perfection, investments in IT do not necessarily provide any strategic advantages to enterprises (Carr 2003). Carr (2003) also claimed that IT has become a commodity on a par with water supply and electrical power and as a result can be viewed an infrastructure technology which is critical to competition, however inconsequential to strategy. This became known as the "IT productivity" paradox. For instance, economic analysis showed no relationship between investments in IT and performance of firms (Brynjolfsson 1993). Although the ignored time lags between the IT investments and productivity gains and mismeasurement between IT capital and outputs have been considered as possible explanations (Brynjolfsson 1993; Fink 1998), this cannot hide the fact that investing in IT often does not unconditionally or directly lead to competitive advantage. According to Rosenberg (2000), as the role of IT has changed dramatically over recent years, it might be too early to estimate the productivity benefits. Even with the fact that IT components are now more cheaply and readily available, skills to utilise and manage the technology may be in short supply or they may be new and untested in organisational settings (Webb & Schlemmer 2008).

Although researchers have investigated the contribution of IT to competitive advantage and firm performance from several perspectives and the studies are fragmented, most of the researchers have acknowledged two main points. Firstly, IT resources are essential, but not

sufficient, for sustained competitive advantage (Hulland & Wade 2004). Secondly, a direct impact of IT on competitive advantage and firm performance does not exist. IT forms part of a complex chain of assets and capabilities and may lead to sustained performance if these form complementarities with other firm competences (Bharadwaj 2000; Zhang 2007). IT can be essential to the firm's long-term competitiveness if it assists to develop, integrate, add and release other key resources over time (Melville, Kraemer & Gurbaxani 2004).

In recent years, the number of studies about the impact of IT on supply chain relationships and performance are increasing. Determining how well IT in supply chain relationships enables various organisational capabilities in a firm can reduce the complexity of evaluating IT business value (McLaren, Head & Yuan 2004). Although some studies have indicated that IT utilisation can lead to productivity, performance and differential and sustainable competitive advantages because it can strengthen linkages between functions within a firm and between firms (Kim & Narasimhan 2002; Venkatraman & Zaheer 1994; Wu, Yeniyurt, Kim & Cavusgil 2006), empirical studies have not shown consistent results. In fact, many studies have pointed out that, in some instances, IT implementation in the supply chain process does not guarantee a stronger firm performance and the impact on firm performance remains unclear (Lucas & Spitler 1999). For example, although the business value of EDI implementation as one the main business to business (B2B) technologies that mediates buyer-supplier relationships has been investigated extensively (Chatfield & Yetton 2000), the results shows that EDI is not always directly and positively related to value creation in the supply chain context (Benjamin, De Long & Scott Morton 1990; Naude, Holland & Sudbury 2000).

Furthermore, existing studies of IT capabilities have several shortcomings when used to model the capabilities enabled in supply chain activities. Firstly, ambiguities in the existing theories and/or using different terminologies for IT capabilities (e.g. EDI volume, breadth, diversity, depth) for their contributions towards enhanced performance determines that the conceptualisation of IT for IT resources is uncertain, leading researchers to conceptualise and use different terms for IT capabilities and resources (Jean 2007). Secondly, there are ambiguities among researchers in using different business processes and capabilities which interact with IT capabilities in the process of value creation. Finally there are some ambiguities in how various IT resources interact with other capabilities and business

processes to create competitive advantage. In addition, empirical evidence on the issue is still fragmented and a comprehensive conceptual framework to integrate different theoretical perspectives is lacking in the literature (Garcia-Dastugue & Lambert 2003; Jean, Sinkovics & Kim 2008).

Hence, there is a need for a conceptual framework which incorporates the drivers for IT resources and IT support for core competences (IT complementary organisational resources) and their impact on supply chain channel capability, as well as their impact on firm performance. Additionally, most studies that examine the impact of IT on competitive advantage and firm performance and in particular the impact of IT in supply chain activities have been conducted in North America. According to Sachan and Datta (2005), the research into supply chain management has been dominated by US and European research, and there is an urgent need to widen the geographical content of the research.

1.5 Research objectives

In line with gaps in the literature, the aim of this study is to understand the productivity impact of B2B enabling technologies usage on supply chain relationships and consequently on their firm performance. Therefore, the underlying research objective of this study is to review and integrate different perspectives and theoretical bases relating to the impact of IT on supply chain channel relationships and firm performance. Although prior studies have demonstrated that IT usage does have beneficial performance and productivity impacts, theoretical frameworks are yet to explain whether and how these usages can create competitive advantage and enhance firm performance.

By integrating different streams of theories, this research specifically aims to:

1- Create a conceptual framework that identifies the detailed dimensions of IT capabilities, supply chain channel capabilities and firm performance.

2- Identify key IT resources in relation to a firm's supply chain activities and develop this notion of IT as an organisational capability created by the synergistic combination of electronic integration, human IT resources and IT complementary organisational resources.

3- Identify the association between IT capabilities and firm performance.

4- Identifies the critical role of business processes and structure dimensions which mediate the impact of IT capabilities on firm performance and creating competitive advantage for a firm.

1.6 Research questions and hypotheses

The present research seeks answers for the following specific questions:

1. Whether and how the IT capabilities interact with supply chain channel capabilities create competitive advantage?
2. Whether and how the IT capabilities interact with supply chain channel capabilities enhance firm performance?

To address the research questions the following hypotheses were developed:

H1a: Electronic integration is positively related to information sharing.

H1b: Electronic integration is positively related to SC coordination.

H1c: Human IT resources are positively related to information sharing.

H1d: Human IT resources are positively related to SC coordination.

H1e: IT complementary organisational resources (IT integration strategy, CEO commitment, and customer orientation) are positively related to information sharing.

H1f: IT complementary organisational resources (IT integration strategy, CEO commitment, and customer orientation) are positively related to SC coordination.

H2a: Information sharing is positively related to SC coordination.

H2b: Information sharing is positively related to SC responsiveness.

H2c: SC coordination is positively related to SC responsiveness.

H3a: Information sharing is positively related to market performance.

H3b: Information sharing is positively related to financial performance.

H3c: SC coordination is positively related to market performance.

H3d: SC coordination is positively related to financial performance.

H3e: SC responsiveness is positively related to market performance.

H3f: SC responsiveness is positively related to financial performance.

1.7 Overview of research methodology

The selected perspective of this study is a positivist approach. The standpoint of view of positivism is that reality can objectively be captured and measured in the world of phenomena and relationship between objects and can be obtained from data which is reasonably precise and representative (Straub, Boudreau & Gefen 2004). A positivism approach suits this research, as it aims to operationalise the constructs and measure interrelationships between constructs. It is common for researchers to utilise multivariate analyses such as structural equation modelling (SEM) and multiple regression techniques to test hypotheses when investigating business orientation and performance especially in supply chain management literature.

In this research study, a quantitative methodology was chosen to examine relationships that exist between IT capabilities, channel capabilities and business outcome related variables. A survey instrument was developed using validated measures from previous research. Data were collected from a sample of companies who are members of GS1 Australia. The data was analysed using statistical techniques including structural equation modelling and finally the research hypotheses were tested to provide meaningful results.

1.8 Outline of remaining chapters

A summary of the chapters and a roadmap to this thesis follows:

Chapter Two provides an extensive literature review on relevant supply chain channel capabilities. It aims at determining their importance in B2B relationships by investigating related concepts and current practices in supply chain management. This includes, for example, identifying the drivers of supply chain responsiveness, classifying coordination

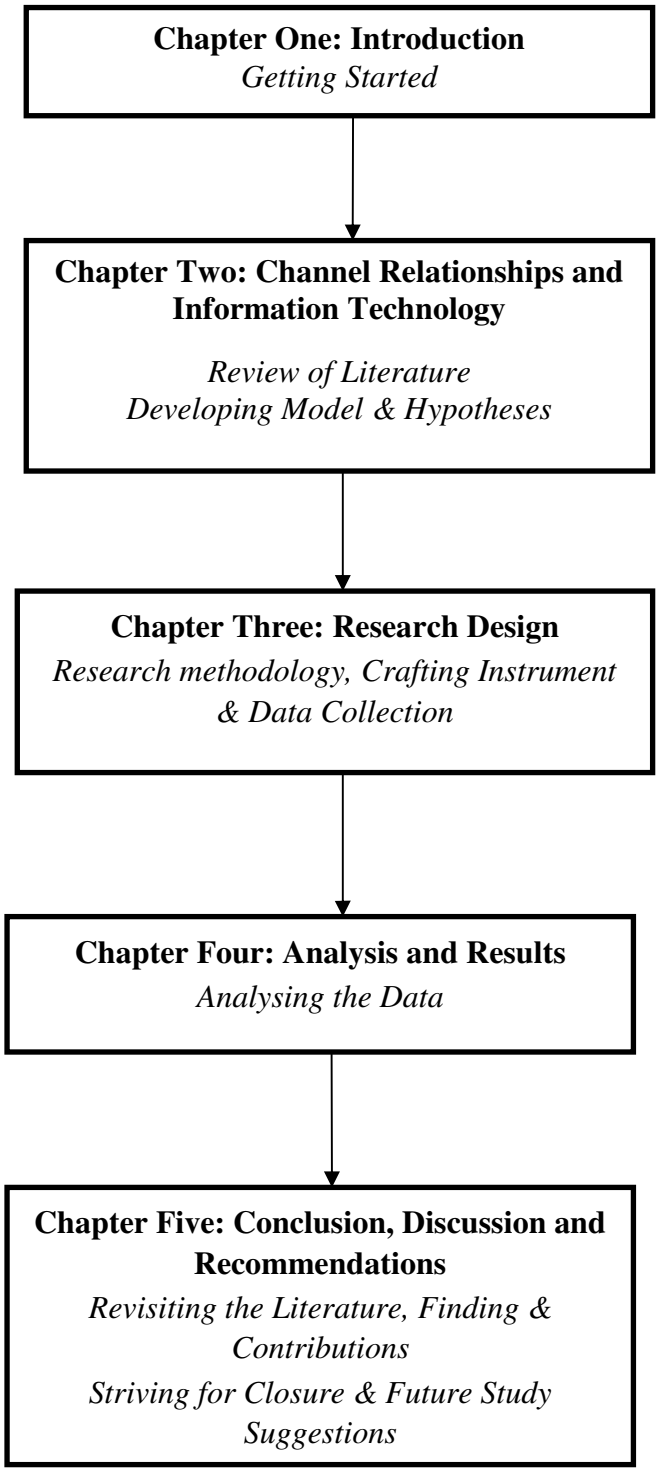
mechanisms, explaining common supply chain coordination practices, and classifying different types of information and their importance in information sharing among supply chains. This chapter also identifies some of the main IT technologies and resources which are used by organisations in relation to their supply chain partners. Additionally, gaps in the literature and research questions are discussed, followed by development of a research model. Finally a suite of research hypotheses are presented.

Chapter Three outlines the research design of this thesis. It describes the context of the research, the unit of analysis and the research methodology, which is essentially a quantitative method and employs quantitative data collection and analysis techniques. Academically rigorous scales for measuring constructs of the research conceptual model are reviewed, and a suitable survey instrument for this research is developed. Later, this chapter explains the statistical techniques and software applications which were used in the quantitative data analysis. Finally, the process of ethics approval for data collection is addressed.

Chapter Four presents the findings following analysis of the quantitative data. Hence, the purpose of this chapter is to summarise and present the results of the information collected in the survey questionnaire and empirically examine and test the hypotheses developed in Chapter Two. The quantitative elements of the data are presented, which includes results of the structural equation modelling (SEM).

Chapter Five discusses the research findings and implications. It provides answers to the research questions and discusses the research hypotheses and associated findings that support the interrelationship between constructs in the research model. Finally, theoretical and practical contributions, and limitations of this study are outlined and recommendations for future studies are proposed.

Figure 1.1 Roadmap to thesis chapters



1.9 Summary

This chapter lays the foundation and serves as a general introduction to the thesis. The importance of IT in improving effectiveness of organisations in the supply chain management area is discussed. Essentially, the manner in which firms implement IT systems and technologies in their supply chain activities to create competitive advantage and enhance firm performance are briefly addressed. Subsequently research problems related to the IT productivity paradox, specifically in relation to supply chain relationships and firm performance, are briefly considered. The research objectives and motivation for this study in order to answer the research questions are discussed. A quantitative methodology is adopted and justified for the purpose of this research, and the overall structure of the thesis is outlined.

Chapter Two

Literature Review – Channel relationships and Information Technology

2.1 Introduction

This chapter reviews and discusses the literature relevant to channel capabilities and the use of information technology (IT) in managing supply chain relationships. The aim of this chapter is to review and integrate different perspectives and theoretical bases pertaining to the impact of IT on supply chain relationships and firm performance. The first section of this chapter reviews definitions and concepts of supply chain relationships and important product characteristics in supply chain strategy. It then outlines the significance of channel relationships in relation to competitive advantage for firms in today's global competitive market. The last part of this section discusses channel capabilities, which in the content of this research are information sharing, SC responsiveness and SC coordination in SC relationships.

The next section of this chapter reviews the literature associated with different types of business to business (B2B) e-commerce technologies that are being used by organisations in their supply chain relationships. It then discusses issues relating to the business value of IT and the impact of IT on firm performance through SC channel capability. The underpinning theories transaction cost economic and resource based view are used to develop a conceptual model of IT in managing supply chain channel relationships aimed at enhancing firm performance. After developing the conceptual model, related hypotheses are presented and discussed. Finally, the efficacy of the research model was validated by conducting interviews with SC professionals.

2.2 Supply chain relationships

According to Morgan and Hunt (1994), the inter-firm relationships paradigm refers to all activities directed towards establishing, developing and maintaining successful relational exchanges. In the past decade, the business community has realised the importance of managing the supply chain as part of broader business strategies, and especially to build and take advantage of collaborative relationships with supply chain partners. Although acknowledging the role of inter-firm relationships in creating sustainable value, many companies have failed to recognise the anticipated outcomes of such relationships (Hsu Kannan, Tan & Leong 2008). One main reason for this is the inability to leverage information flows within the supply chain, whether because of incapability or unwillingness to do so, or a lack of understanding regarding how to do so (Muckstadt, Murray, Rappold & Collins 2001). In the current global market with power shifting to customer and rapidly shrinking product life cycles, companies should constantly find new ways to design and deliver high-quality products and services in a suitable time. Hence a well-integrated supply chain is one of the main business strategies to improve supply chain performance.

It is argued that Porter's value chain model (1980, 1998) is the theoretical foundation for supply chain integration, and particularly, its notion of linkages (Vickery, Jayaram, Droge, & Calantone 2003). A "linkage" is the relationship between the way in which one value activity is performed and the cost or performance of another. Porter clarified the reorganisation and strategic utilisation of linkages within a firm's value chain (i.e. horizontal linkages) and between the firm's value chain and the value chains of its customers and suppliers (i.e. vertical linkages). Therefore, the core purpose of SC integration is related to optimising the linkages between value activities, in particular, optimising vertical linkages. Such integration should lead to superior firm performance (Frohlich & Westbrook 2001; Kannan & Handfield 1998).

A growing body of literature has recommended that the higher the degree of integration across the supply chain, the greater is a firm's performance. Tan, Kannan and Ghosh (1999) note that when companies "integrate and act as a single entity, performance is enhanced throughout the chain". Other literature has highlighted the problem of not fully integrating with upstream suppliers and downstream customers (Fawcett & Magnan 2002; Frohlich &

Westbrook 2002; Hammel & Kopczak 1993; Lee & Billington 1992). Lack of coordination has been shown to create the classic magnification of demand up the supply chain, known as the bullwhip effect, resulting in alternating excess inventory and stock-outs (Sanders 2007). Another example can be delays in information transfer among the firm and its SC partners, often attributed to the distributed location of information across the supply chain and its inaccessibility, leading to reduced information visibility, poor forms of interaction and mismatches between demand and supply (Patnayakuni, Rai & Seth 2006).

Downstream integration (with customers) involves determining customer requirements and tailoring internal activities to meet these requirements (Koufteros, Vonderembse & Jayaram 2005). As a firm gets to know its customers better and becomes committed to understanding and meeting their needs, a strong linkage is forged between them. Integration with customers ensures that their voice plays a vital role in the innovative process within the organisation. On the other side, for upstream integration (with suppliers), a firm requires strong information sharing and coordination activities (Fawcett & Magnan 2002; Harland 1996; Sahin & Robinson 2002). Supplier partnering seeks to bring participants early in the product life cycle, thus entailing early supplier involvement in product design or acquisition of access to superior technical capabilities (Narasimhan & Das 1999; Petersen, Handfield & Ragatz 2005). An example of upstream integration would be the sharing of production plans and costs with suppliers, while downstream examples include shared information and processes associated with collaborative planning, forecasting and replenishment (CPFR) (Germain & Iyer 2006). However, attaining supply chain integration is not an easy task. The often conflicting objectives of the channel members and the continuously evolving dynamic structure of the supply chain pose many challenges. A better understanding of the benefits of supply chain integration promotes channel relationships that foster the sharing of technological and strategic efforts (Sahin & Robinson 2002).

2.3 Supply chain strategies and product characteristics

Companies by using different supply chain integration approaches such as increased information sharing, supply chain planning tools, collaborative forecasting and replenishment, as well as third-party logistics solutions are attempting to achieve the best possible performance from their supply chains. However, before any of these measures are

taken, the design of the supply chain has to be considered (Selldin & Olhager 2007). Fine (2000) argues about supply chain design being a separate dimension to process design and product. Hayes and Wheelwright (1984) examined the relationship between process choice and product characteristics by introducing the product-process matrix, which explains the best fit between product and process designs. It is argued by many scholars that companies by identifying the importance of finding the best process and supply chain for their products, not only improve their manufacturing operations but also their supply chain operations (Selldin & Olhager 2007; Randall & Ulrich 2001; Qi, Boyer & Zhao 2009). Hence, the individual manufacturing company requires tools to match the supply chain to their product lines.

According to Fisher (1997) the first step in devising an effective supply chain strategy is to consider the nature of demand for products that a company supplies. Fisher believes that products on the basis of their demand patterns fall into one of two categories: primary functional or primary innovative. Functional products are characterized by longer product life cycles, lower product variety, and relatively long lead times. In contrast, innovative products are characterized by short life cycles, high product variety, and short lead times. Based on each category, companies require different kind of supply chains. In fact, the root cause of the problem plaguing many supply chains is a mismatch between the type of product and the type of supply chain (Fisher 1997).

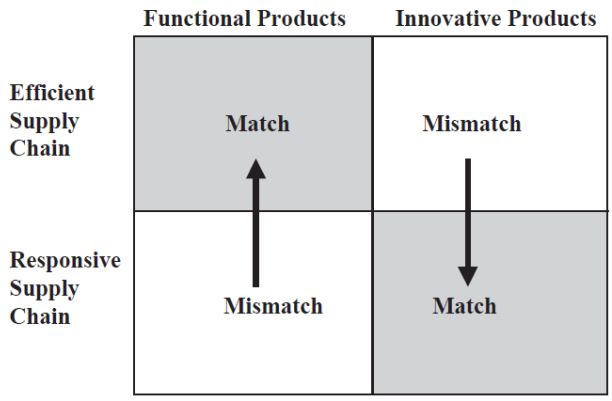
A supply chain, on the other hand, can emphasize the physical function in delivering the goods or the market mediating function for conveying information. A functional product is assumed to require a physically efficient supply chain, whereas an innovative product would require a market-responsive supply chain (Selldin & Olhager 2007; Qi, Boyer & Zhao 2009). Similar studies for matching supply chains and products have been done by Ramdas and Spekman (2000) and Lee (2002), which build on Fisher's model. Another perspective on alternative supply chain designs is the distinction between lean and agile supply chains (see, for instance, Aitken, Christopher & Towill 2002; Mason-Jones, Naylor & Towill 2000), where a lean supply chain is physically efficient, using Fisher's terminology, and an agile supply chain has similar characteristics as being market-responsive in Fisher's model. The characteristics for functional and innovative products by Fisher are included in table 2.1 and figure 2.1.

Table 2.1: Characteristics for functional versus innovative product type and physically efficient versus market responsive supply chains

Product aspects	Functional (predictable demand)	Innovative (unpredictable demand)
Product life cycle	More than two years	Three months to one year
Contribution margin	5-20 percent	20-60 percent
Product variety	Low (10-20 variants per category)	High (often millions of variants per category)
Average margin of error in the forecast at the time production is committed	10 percent	40-100 percent
Average stock-out rate	1-2 percent	10-40 percent
Average forced end-of-season markdown as percentage of full price	0 percent	0-25 percent
Lead time required for made to order products	Six months to one year	One day to two weeks
Supply chain design aspects	Physically efficient process	Market-responsive process
Primary purpose	Supply predictable demand efficiently at the lowest possible cost	Respond quickly to unpredictable demand in order to minimize stock-outs, forced markdowns, and obsolete inventory
Manufacturing focus	Maintain high average utilization rate	Deploy excess buffer capacity
Inventory strategy	Generate high turns and minimize inventory throughout the chain	Deploy significant buffer stocks of parts or finished goods
Lead-time focus	Shorten lead time as long as it does not increase cost	Invest aggressively in ways to reduce lead time
Approach to choosing suppliers	Select primary for cost and quality	Select primary for speed, flexible and quality
Product design strategy	Maximize performance and minimize cost	Use modular design in order to postpone product differentiation for as long as possible

Source: Fisher (1997)

Figure 2.1: Matching supply chain with product characteristics



Source: Fisher (1997)

The main aim of a lean supply chain strategy is to reduce cost and enhance efficiency through elimination of wastes in both inter and intra-organizational processes. Lean supply chains are best matched with a relatively stable environment. In contrast to lean, the main objective of an agile (responsive) supply chain is to provide customer-driven products with unique features to the market quickly in order to maintain a competitive advantage in a rapidly changing environment (Randall, Morgan & Morton 2003). Decreasing product life cycles and rapidly changing customer requirements have increased the pressure on the entire supply chain to provide products and services in a quicker and more responsive manner. Particularly, with the emergence of e-business, the responsiveness of the supply chain becomes an increasingly important competitive advantage in the marketplace (Qi, Boyer & Zhao 2009; Swafford, Ghosh & Murthy 2008).

2.4 Supply chain responsiveness

A firm's ability to respond to competitive challenges and to sustain its competitive advantage is a main element of success in today's global market place (Prahalad & Hamel 1990; Teece, Pisano & Shuen 1997). Companies in order to respond to the challenges and demands of the twenty-first century are undergoing a revolution in relation to implementing new operational strategies and information technologies. Firms need to be responsive to customers' unique and rapidly changing requirements. Companies are now exploring the potential of the concept of supply chain integration to improve their revenue growth. They are attempting to develop

responsive supply chains to get their products to the market faster than their main competitors. Therefore, effective supply chain relationships are a vital strategy for success in global and e-markets (Gunasekaran, Lai & Cheng 2008; Swafford, Ghosh & Murthy 2008).

With the recent global competition and increasing levels of product variety and customisation, successful firms are those that accurately predict market trends and rapidly respond to changing customer requirements (Stalk, Evans & Shulman 1992). This means that end customers in the market place determine the success or failure of SCs and therefore this is considered as one of the principal aims of supply chain integration (Narasimhan & Jayaram 1998; Towill & Christopher 2003). According to Towill and Christopher (2003), "getting the right product, at the right price, at the right time to the consumer is not only the linchpin to competitive success but also the key to survival". This shows that in the new global market environment companies have to look at flexible ways to meet customer demand. They should focus on optimising their core capabilities and activities to maximise speed of response to customer demand. In fact, SCs are forced to be responsive to continuously changing markets and business environment as a result of increasing customer demand (product variety and customisation) (Storey, Emberson & Reade 2005; Yang & Burns 2003), and current events of supply disruptions (Christopher, Lowson & Peck 2004; Gosain, Malhotra & El Sawy 2004; Lee 2004). Therefore, it is incumbent on academics and practitioners to strive for a better understanding of the element of responsiveness.

Owning to the lack of a comprehensive definition for SC responsiveness, Reichhart and Holweg (2007) attempted to define responsiveness and its relation to the concept of flexibility, based on existing definitions of flexibility and responsiveness from manufacturing systems and SCM concepts. According to Holweg (2005) and Reichhart and Holweg (2007), flexibility adds value in many ways in supply chain relationships and is defined as: "The ability of any system to adapt to internal or external influences, thereby acting or responding to achieve a desired outcome. External flexibility can be linked to achieving a competitive advantage, such as speed of delivery (what the customer sees). Internal flexibility on the other hand is the internal means by which external flexibility can be achieved (what can we do)." Although there are various definitions of responsiveness (see table 2.2), most of them are similar to that of Catalan and Kotzab (2003) who defined it as the ability to respond and adapt effectively on time based on the ability to "read" and understand actual market signals.

Table 2.2 lists the definitions of responsiveness as articulated by the various authors.

Table 2.2: Definitions of responsiveness

Definitions	References
The ability to respond in a timely manner to customers' needs and wants	(Tunc & Gupta 1993)
The ability to fill customers' orders quickly	(Upton 1995)
The ability to react purposefully and within an appropriate timescale, to significant events, opportunities or threats to bring about or maintain competitive advantage	(Barclay, Poolton & Dann 1996)
The ability of a manufacturing system to make a rapid and balanced response to the predictable and unpredictable changes characterising today's manufacturing environment	(Gindy, Saad & Yue 1999)
The ability of a production system to achieve its operational goals in the presence of disturbances	(Matson & McFarlane 1999)
The ability to respond and adapt time-effectively based on the ability to read and understand actual market signals	(Catalan & Kotzab 2003)
The ability to plan and control the flow of materials through a sequence of SC processes in order to meet end customer buying behaviour	(Harrison & Godsell 2003)
The firm's ability to respond in a timely manner to the needs and wants of its customers	(Chen, Paulraj & Lado 2004)
The ability of the manufacturing system or organisation to respond to customer requests in the marketplace	(Holweg 2005)
Product-specific action taken as a function of the knowledge generated and disseminated in logistics operations	(Hult, Ketchen, Cavusgil & Calantone 2006)
The speed with which the system can adjust its output within the available range of the four external flexibility types in response to an external stimulus	(Reichhart & Holweg 2007)

Source: Bernardes & Hanna (2009)

It is apparent that most of the researchers link responsiveness exclusively to external events. Reichhart and Holweg (2007) provided a framework (see table 2.3) for analysing SC responsiveness and also determined the main external factors.

Table 2.3: Framework for analysing SC responsiveness

Author, Year	Characteristics of framework	Factors considered
(Kritchanchai & MacCarthy 1999)	Framework for comparing cross-industry responsiveness of the order fulfilment process	Nature of product; demand; major impact stimuli; awareness; capabilities; goals
(Van Hoek, Harrison & Christopher 2001)	Framework measuring a supply chain's "agile capabilities" based on five dimensions of agility	Customer sensitivity; virtual integration; process integration; network integration; measurement
(Catalan & Kotzab 2003)	Responsiveness index (rating) based on four components grouped into two broad categories: time effective flow of goods and information and demand transparency	Lead time (production and distribution lead-time); postponement strategies; bullwhip effect; information exchange
(Lummus, Duclos & Vokurka 2003)	Analysis split into components and outcomes of supply chain flexibility Five components and two outcomes	Components; operation systems; logistics processes; supply network; organisational design; information systems; outcomes; customer satisfaction (including service and responsiveness); improved supply chain asset utilisation
(Holweg 2005)	Three dimensions of responsiveness (volume, product, process)	Customer lead-times; volume stability; demand specifications (pareto); product variety (external, internal); point of customisation; product life cycle; total order-to-delivery (OTD) time; distribution lead-time; supply chain responsiveness lead-time; decoupling points

Source: Reichhart & Holweg (2007)

The need for SCs to become responsive can be derived from the factors listed in table 2.3. These can be divided into three main areas: demand uncertainty and variability, product variety, and lead-time compression.

2.4.1 Demand uncertainty and variability

Uncertainty as one of the main drivers of being responsive is discussed by many researchers (Davis 1993; Fisher, Hammond, Obermeyer & Raman 1994; Randall, Morgan & Morton 2003). In fact, it is not necessary to be responsive when reliable information about demand conditions is available for decision making. The need generally occurs owning to the uncertainty relating to volume and product mix changes in customer demand signals. Various researchers have studied the factors that make responsiveness or flexibility an essential element of individual manufacturing systems (Azzone, Masella & Bertele 1991; Matson & McFarlane 1999) or of whole supply chains (Christopher 2000; Fisher et al. 1994; Storey, Emberson & Reade 2005). Uncertainty itself can stem from three sources: process uncertainty, supply uncertainty and demand uncertainty (Davis 1993). Out of these, demand uncertainty is the most severe type (Davis 1993; McCutcheon, Raturi & Meredith 1994).

The impact of unstable scheduling/ planning on SCs is very considerable and has been discussed by many researchers (Griffiths & Margetts 2000; Inman & Gonsalvez 1997; Krajewski, Wei & Tang 2005). In addition to schedule instability (or demand uncertainty in general), schedule variability (or demand variability) is attributed to responsiveness (Harrison 1996). Schedules can be stable by not deviating from the previous schedule or forecast, and can be level (i.e. not variable), whereby the day-to-day changes are kept small within predefined boundaries. Inman and Gonzalves (1997) and Harrison (1996) believe that there are differences between stable schedules and level schedules with regard to their impact on supply chains. The existing literature on schedule variations (both instability and variability) often had difficulty in noticeably differentiating between these two concepts (Liker & Wu 2000).

Both demand uncertainty and variability are involved in most operations and may need different types of responsiveness based on their nature (i.e. product mix vs. volume vs. delivery changes). Therefore, different internal capabilities might be necessary, at least on a manufacturing system level, dependent on the type of demand uncertainty or variability

(Suarez, Cusumano & Fine 1995). In many cases, impact of uncertainty can be manifested in SCs.

For instance, Hewlett-Packard used to have high inventory levels in order to protect against demand uncertainty in their SC until they found that some product configuration decisions could be postponed by using a more modular product architecture (Davis 1993; Feitzinger & Lee 1997). Although they could not finally decrease the total demand uncertainty originating from end customers, they moved to a less costly strategy for dealing with the issue.

2.4.2 Product variety

Managing product variety and its impact on a firm's wider performance has been discussed by many authors (Da Silveira 1998; Lancaster 1990; Ramdas 2003). It is argued that competitive importance of product variety in today's markets and its potential financial impact for product development activities and manufacturing operations are the main reasons for focusing on managing product variety (Gilmore & Pine 1997; Lampel & Mintzberg 1996; McCutcheon, Raturi & Meredith 1994). Demand uncertainty is amplified by product variety, because the same aggregated demand is distributed over more stock keeping units (SKUs), leading to increase in aggregated inaccuracies associated with each forecast (Fisher et al. 1994; Randall & Ulrich 2001). This product variety leads to increased mix responsiveness as a result of the increasing external mix flexibility and customers are not prepared to accept longer lead time (Berry & Cooper 1999). These issues have also caused companies to rethink the level of product variety that is actually demanded by their customers (Fisher et al. 1994; MacDuffie, Sethuraman & Fisher 1996).

According to Holweg and Pil, product variety has three dimensions (Reichhart & Holweg 2007). The first dimension is external variety (product proliferation) which is in relation to the number of SKUs (including their variations) available to a firm's customers at any point in time. The second dimension is internal variety which is the complexity within a firm's manufacturing processes and could be gauged by the number and variety of necessary components for manufacturing a given product. Distinctly, a high level of modularisation (Starr 1965) supports a limit for the internal variety under a given external variety. The last dimension is dynamic variety which is related to shortened product life cycles, and the speed that consumers have access to new products. It has been argued by many researchers that due

to lack of past demand pattern data for new products and the chance of unexpected customer reaction to them, predicting demand for the new products is always harder at the beginning of the product life cycle (Davis 1993; Fisher et al. 1994). Hence, higher dynamic variety amplifies demand uncertainty. Product variety can also slow down SC responsiveness while it makes the use of finished goods safety stocks more costly (Reichhart & Holweg 2007).

SC strategy should be determined by the product variety that a firm in a given industry wants to offers to its customers, but it is limited by its SC capabilities as well (Fisher 1997). For instance, Dell, which is well known for its responsive assemble-to-order SC, has the ability to offer several varieties of a PC or laptop computer to its customers, since the computer is only assembled when the exact specifications are identified (Lee 2002; Simchi-Levi & Kaminsky 2003). However, Dell's competitors who sell their products through retail outlets using a made to forecast model are forced to restrict product variety to a small number of variations. A customer who would like to buy a PC with a faster CPU might have to take a larger hard drive and pay for it, even though it may not be required.

2.4.3 Lead-time compression

Time-based competition enhances the need to be responsive, as the firm or SC is given less time to respond to new orders or changes in existing ones (McCutcheon, Raturi & Meredith 1994; Stalk, Evans & Shulman 1992). Mather (1988) suggests different explanation for why lead-time compression requires additional responsiveness. Using the P:D ratio, a concept dating back to work by Shingo and Dillon (1989), they clarify how the forecasting horizon becomes longer if the customer lead-time "D" reduces in relation to the production lead-time "P". By increasing the time needed, the forecast becomes less reliable (Mather 1988; Randall & Ulrich 2001) which leads to higher demand uncertainty.

2.5 Leveraging supplier relations

Relationship with suppliers is critical in order to have a responsive supply chain in fast-changing markets. Invariably the lead time of in-bound suppliers limits a manufacturer's response to customers' needs. Likewise, the time for new product introduction can be noticeably reduced by the involvement of suppliers in the innovation process (Swafford, Ghosh & Murthy 2006). There are a number of prerequisites to leverage the opportunity for

greater responsiveness through closer supplier relationships needs a number of prerequisite (Christopher 2000).

The first prerequisite is that responsive companies need to identify a limited number of strategic suppliers with whom they can work as partners through linked systems and processes. Opportunity for establishing information-based and paperless systems utilising the concept of vendor managed inventory, for instance, are clearly greater when both supplier and buyer consider each other as critical links in a more competitive supply chain.

The second prerequisite relates to a high level of shared information among supply chain partners. It is essential to have a clear visibility of the downstream demand, that is, data associated with real demand needs to be captured as far down the chain as possible and shared with upstream suppliers. Also it is vital to have an efficient information technology system to facilitate the transfer of information. There needs to be a willingness amongst the supply chain partners to put aside any previous mistrust and instead to create an environment in which information can freely flow in both directions throughout the chain.

The final prerequisite is the requirement for a high level of connectivity and coordination between the firm and its supply chain partners. This implies not just the exchange of information on demand and inventory levels, but multiple, collaborative working relationships among supply chain partners. For example, these days it is a common coordination approach for many companies to create supplier development teams that are cross-functional and, as such, are intended to interface with the equivalent customers' management team within the supplying organization(Christopher 2000; Kim, Cavusgil and Calantone 2006).

2.6 Supply chain coordination

According to Dyer and Singh (1998), a firm needs to develop effective coordination with its SC partners with the aim of maximising the potential for converting competitive advantage into profitability. Coordination is accomplished once a decision maker in the SC, acting rationally, makes decisions that are efficient for the whole SC (Gupta & Weerawat 2006). In SC relationships, companies are dependent on the performance of other firms. Therefore, it is necessary for a company's success to manage these dependencies and different resource

flows (Danese, Romano & Vinelli 2004; Patnayakuni, Rai & Seth 2006). SC coordination is a vehicle for redesigning workflow, decision rights and resources among SC members to provide improved performance (Lee 2000). Some researchers also suggest that coping with uncertainty is the main motivation for SC coordination (Simatupang, Sandroto & Lubis 2004). There are some studies in the literature regarding coordination of different functions of the supply chain; nevertheless, the study of coordinating functions in isolation may not help to coordinate the whole supply chain.

Although the importance of coordination is recognised, there are few studies which attempt to develop a holistic view, and there does not seem to be a unique definition. There are reported attempts in the literature regarding proposing different coordination models which consider isolated activities or different functions of SC. There is no unique perspective on coordination, but the lack of coordination can be easily expressed through a variety of surrogate measures (Lewis & Talalayevsky 2004). One of the most commonly acknowledged definitions in the literature for coordination is "the act of managing dependencies between entities and the joint effort of entities working together towards mutually defined goals" (Malone & Crowston 1994). In other words, coordination is an essential requirement for achieving the mutual goal of the SC as a whole, in addition to those of the participating units, given the nature of interdependence between them (Simatupang, Wright & Sridharan 2002). Due to SCs with decreased profit margins, intensive competition, pressure for keeping low inventory and enormous cost related to capabilities, coordination becomes very important.

The lack of coordination can lead to poor performance of SCs. The imbalance of demand and supply might lead to increase in the costs of stock-out, trans-shipment, expediting, markdown, advertising and sale preparation, excess inventory, obsolescence and disposal (Fisher et al. 1994). On the other hand, many authors also mention the benefits from coordination of supply chain activities in the literature. Some of the potential benefits of coordination are shown in table 2.4.

Table 2.4: Benefits of SC coordination

Author	Benefits of SC Coordination
(Min, Mentzer & Ladd 2007)	Supply chain coordination provides risk reduction, access to resources, and competitive advantage
(Porter 1985)	Coordination with upstream and downstream supply chain members is not a zero sum game; it lowers costs for all participants
(Christiaanse & Kumar 2000)	Supply chain coordination dictates the cost improvement and value that can be gained
(Jorgensen & Zaccour 2003)	Uncoordinated decision making creates inefficiency, with channel members' profits significantly lower for each member independently and collectively than what could be achieved with coordination
(Lee, Padmanabhan & Whang 1997a)	Coordination of pricing, transportation, inventory and ownership decisions between upstream and downstream supply chain participants can provide inventory reductions of up to 25%
(Sahin & Robinson 2005)	Partial coordination (defined as the manufacturer's coordination of multiple item replenishments with transportation decisions) results in over 30% system-wide cost reduction
(Cachon 2004), (Jeuland & Shugan 1983), (McDermott, Franzak & Little 1993)	More inter-organisational coordination yields lower total costs and higher profits

Source: Fugate, Sahin & Mentzer (2006)

Current developments in the information technology (IT) area facilitate companies to raise the degree of interaction with their supply chain partners and develop tighter coordination of their SC activities. Coordination mechanisms, which are tools to deal with primary coordination problems, are at the core of SCM practices and research. These mechanisms, extensively utilised in industry, are influential in eliminating SC sub-optimisation and in reaching desirable performance outcomes (Fugate, Sahin & Mentzer 2006; Kumar & Seth 1998).

Merging the research efforts on coordination mechanisms needs identifying approaches to coordination and the mechanisms designed to solve explicit problems. According to Sahin and Robinson (2002; 2005), centralised decision making and decentralised (independent) decision making utilising coordination mechanisms are the two major organisational approaches to coordination. The methods which are mentioned above, along with Whang's

(1995) three organisational perspectives in his taxonomy of coordination, are single-person, team-based and nexus-of-contract approaches.

The single person perspective which is similar to the centralised decision making approach of Sahin and Robinson (2002) indicates that a system is managed by a single decision maker with access to all the information and who makes system optimal decisions. This approach is generally used by operations researchers in developing economic models for SC coordination, even if the applicability of the approach in industry is uncertain (Whang 1995). In contrast, the team based approach is a cooperative attempt between SC members, who have limited information and hence work together, communicate and coordinate their activities to accomplish system optimisation. It seems that this approach is the most commonly followed one. The third approach, nexus-of-contract which is based on agency theory from Jensen and Meckling (1976), concentrates on obviating the sub-optimisation tendency of self-interested SC members by adjusting their incentives with those of the system through contracts. Furthermore, Whang (1995) clarified functional, cross-functional and inter-organisational coordination as demonstrating different levels of coordination.

Identifying coordination types as structured or unstructured and formal or informal is another approach (Olson, Walker Jr & Ruekert 1995). This depends on the extent to which firms apply formal design of roles and mechanisms to align activities and flows within SC (Lusch & Brown 1996; Poppo & Zenger 2002). However, standardisation of tasks and mutual alignment is necessary among SC members for achieving coordination (Thomson 1967). Thompson (1967) stresses the requirements to define and determine each SC member's task, including inputs, outputs, processes and skills, and admits the need to establish mutual adjustments by using norms. Previously many researchers attempted to define a common understanding of behaviour that is accepted and essential to SC relationships and are unwritten mechanisms that are vital in accomplishing SC coordination (Dahlstrom, McNeilly & Speh 1996; Fisher, Maltz & Jaworski 1997; Morgan & Hunt 1994). Gundlach, Achrol and Mentzer (1995) strongly promote the utilisation of norms as a coordination mechanism. The literature highlights examples of norms in coordination such as mutuality, solidity, flexibility, restraint in the use of power, harmonisation of power and concern for reputation (Achrol & Gundlach 1999; Carson, Devinney, Dowling & John 1999; Johnson 1999; Johnson &

Houston 2000; Poppo & Zenger 2002). These norms have an important role in coordinating supply chains through team-based approaches.

The above categorisations are organisational perspectives/ general approaches on categorising coordination to type/style as opposed to particular mechanisms. In contrast, a coordination mechanism is a specific tool designed to refer to a specific coordination problem and can be used for any of the above general organisational approaches. In order to categorise coordination mechanisms as tools needs understanding the specific problem and its suggested solution. Because of the unique nature of each problem, categorising the different coordination mechanisms is a difficult and complicated task. In an effort to provide comprehensive coordination mechanisms, Sahin and Robinson (2002) suggested price, non-price, buy-back and returns policies, quantity flexibility and allocation rules as major categories. Fugate, Sahin and Mentzer (2006), in their research based on Sahin and Robinson's (2002) study, classified coordination mechanisms into three major categories: price, non-price and flow coordination (see table 2.5).

Table 2.5: Coordination mechanisms

Price coordination	Non-price coordination	Flow coordination
Quantity discount	Quantity flexibility	VMI (vendor managed inventory)
Two-part tariffs	Allocation rules	Quick response
Buy-back/ returns policy	Promotional allowances/ Cooperative advertising	CPFR (collaborative planning, forecasting and replenishment)
	Exclusive dealings	ECR (efficient consumer response)
	Exclusive territories	Postponement

Source: Fugate, Sahin and Mentzer (2006)

2.6.1 Price coordination mechanisms

It is common practice to use price for coordination between buyers and sellers. For this purpose, discount policy schemes are often used (Chen, Federgruen & Zheng 2001; Gerstner & Hess 1995; Jorgensen & Zaccour 2003). Spengler (1950) asserted that quantity discount can encourage the retailer to enhance the replenishment quantity and eliminate system sub-optimisation. Buy-back and returns policies as coordination mechanisms have also received considerable attention (Pasternack 1985).

Buy-back contracts have been identified as useful tools, particularly for short shelf life and seasonal demand products. This allows a retailer to return any portion of the initial order at a predetermined price (Sahin & Robinson 2002). Models such as newsvendors (also known as "newsboy") are used to verifying the optimal single-order quantity by balancing the order, inventory and backorder costs that frequently apply for evaluation of the best possible pricing and returns policies (Fugate, Sahin & Mentzer 2006; Zipkin 2000).

A two-part tariff (all unit or incremental quantity discounts) is another mechanism for price coordination (Bergen, Dutta & Walker Jr 1992; Tsay & Agrawal 2000) where a supplier offers the buyer a constant unit wholesale price and a fixed fee. The buyer chooses their order quantity based on internal cost structure, wholesale price and fixed fee offered in the contract.

2.6.2 Non-price coordination mechanisms

Non-price coordination mechanisms consist of allocation rules, cooperative advertising, quantity flexibility contracts, promotional allowances and exclusive dealings (Bergen & John 1997; Frazier 1999; Iyer & Bergen 1997; Sahin & Robinson 2002; Tsay & Agrawal 2000). Allocation rules and quantity flexibility contracts are the most often discussed. Through quantity flexibility contracts, the buyer can obtain a different quantity than the original quantity estimate (Lariviere 1999). Quantity flexibility contracts can be established in different forms, for instance, as back-up agreements that allow a buyer to buy a higher (but limited) quantity than their initial order (Eppen & Iyer 1997), minimum purchase quantity contracts (Bassok & Anupindi 1997) or special contracts that establish terms and conditions where the buyers require to purchase a minimum quantity and the suppliers require to deliver up to a certain quantity if the demand goes over the forecast (Tsay 1999).

In relation to allocation rules mechanism, suppliers generally face excess demand from buyers (e.g. retailers) that may not be possible to be delivered through their existing capacity levels. In these cases, the suppliers establish rules to allocate the scarce capacity between the buyers. Buyers, on the other hand, recognising the scarcity of capacity, distort their orders in anticipation of acquiring their desired order quantities. A number of allocation rules have been examined to mitigate the adversarial impact of demand distortion as the result of capacity shortage (Cachon & Lariviere 2001).

2.6.3 Flow coordination mechanisms

Flow coordination mechanisms designed to manage information and product flows in supply chains have been described extensively by Sahin and Robinson (2002) and Fugate, Sahin and Mentzer (2006). Sahin and Robinson (2002) provide a broad literature review on product flow coordination and information sharing in supply chains, classifying the literature based on the degree of information sharing and coordination.

Vendor managed inventory (VMI), quick response (QR), collaborative planning, forecasting and replenishment (CPFR), efficient consumer response (ECR) and continuous replenishment planning (CRP) are some of the most common examples of flow coordination mechanisms which are regularly cited in literature (Angulo, Nachtmann & Waller 2004; Bowersox, Closs & Stank 1999; Brown & Bukovinsky 2001; Daugherty, Myers & Autry 1999; Frohlich 2002b; McCarthy & Golicic 2002; Pagh & Cooper 1998; Waller, Johnson & Davis 1999). In the following sections, each of these will be explained briefly.

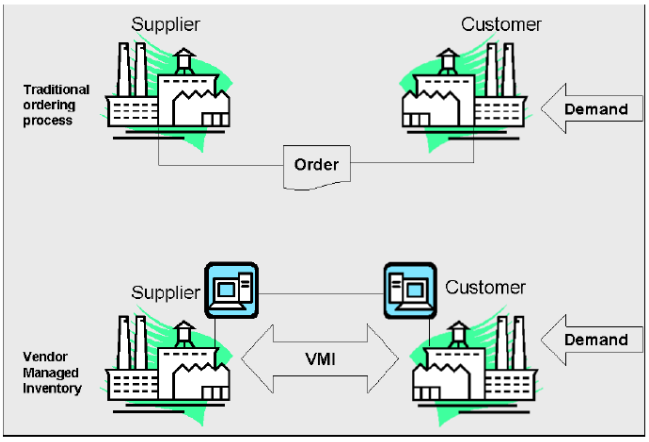
2.6.3.1 Vendor managed inventory (VMI)

Vendor managed inventory focuses on cooperation among business partners where the supplier, with the help of customer demand and inventory level information, manages and replenishes the customer's inventory (Sahin & Robinson 2002). The supplier controls the buyer's inventory levels and makes periodic replenishment decisions involving order quantities, delivery mode and timing of replenishments. By correct implementation of VMI programs, companies are able to improve their supply chain operations and therefore better coordinate their product flow to their customers (Lapide 1999). Thus, it is argued that VMI is a promising solution when experiencing a supply-demand mismatch (Gattorna 1998).

In traditional order-delivery process, the customer usually determines the amount and timing of deliveries of each product required from the supplier. The task of the supplier is then to fulfil this as precisely as possible (Kaipia, Holmström & Tanskanen 2002). However, this method can bring some inefficiency issues for supply chain members. First, the suppliers have no advance warning of requirements but are forced to make forecasts about them. Therefore they usually carry an unnecessary high level of safety stock on these forecasts. Second, the suppliers are usually faced with unexpected short-term demands for products

which lead to many changes in their production and distribution schedules and therefore additional costs. As a result of this, customer service goes down because of higher level of stock-outs (Christopher 1999). It is argued that VMI is an alternative to the traditional order process and it can provide more effective processes in the supply chain (Danielsson & Lundqvist 2005). Figure 2.2 depicts how the customer places an order in the traditional ordering process, and how the supplier electronically has immediate access to demand information when using VMI.

Figure 2.2: Traditional ordering process vs. VMI



Source: Danielsson & Lundqvist (2005)

There are many definitions of vendor managed inventory, differing in supplier's responsibility, level of integration among customer and supplier, and inventory's ownership. However, in each of the alternative levels, the supplier has access to the customer's information which is critical to the supplier via some form of IT solution (Danielsson & Lundqvist 2005). Most researchers claim that the information sharing in a VMI relationship is done electronically, however Waller, Johnson and Davis (1999) argue it can be shared either physically or electronically. Lapide (1999) describes VMI as follows: "Where a supplier manages its customers' inventories of its products, including setting inventory level targets, usually based on achieving a level of service specified by the customer. The inventories might be held on consignment (i.e. owned by the supplier) or owned by the customer".

The concept of VMI relationship has been in existence for several decades, but recent information technology has made its use as a successful business model a reality (Disney &

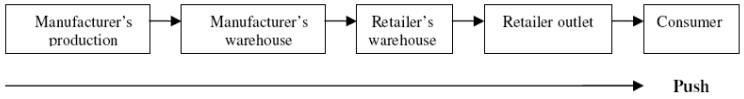
Towill 2003). Furthermore, technology costs associated with VMI are also declining. For instance, using electronic data interchange (EDI) with trading partners is becoming noticeably less costly due to the availability of web EDI software (Waller, Johnson & Davis 1999).

2.6.3.2 Efficient consumer response (ECR)

The ECR concept borrows heavily from earlier logistics development such as just in time and quick response (Wood 1993). It is an advanced logistical system approach, designed to integrate and rationalise product replenishment across the supply chain (Balsmeier & Voisin 1996). ECR initiatives rely on partnerships among retailers and manufacturers as well as a truly integrated approach to supply chain management for minimising inventory and optimising the supply chain's function of meeting consumer demand. ECR underlines the advantages of eliminating non-value-adding activities from the supply chain plus the benefits of information sharing along the supply chain (Wood 1993). It includes a number of important tools for inventory and demand management, and raises industrial awareness of the potential benefits of business process integration to increase supply chain efficiency and customer value (Cooper, Lambert & Pagh 1997).

For instance, one of the major characteristics of the traditional supply chains was the push principle. It was used to push both retailers' and manufacturers' products downstream in the supply chain without considering retailers' sales and consumers' needs. Therefore, the production was not synchronised with the demand, retailers purchased a high volume of products in order to get discounts and there was no coordination among their sales and purchasing departments for meeting customers' demand. Consequently, high buffers of inventory were built in the whole supply chain especially in retailers' distribution centres and stores (Seifert 2003). Figure 2.3 shows the process chain before the adoption of ECR.

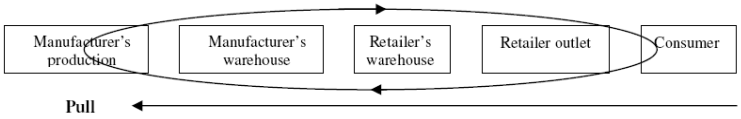
Figure 2.3: Process chain without ECR



Source: Seifert (2003)

The ECR concept uses the pull principle in the supply chain. In this approach, products are not pushed downstream, but the main part for the engineering of the supply chain is the consumer demand that is captured through seamless information sharing among the supply chain partners. Therefore, the vision of demand driven supply chains is achievable by ECR (Seifert 2003). Figure 2.4 demonstrates the process chain with ECR.

Figure 2.4: Process chain with ECR



Source: Seifert (2003)

2.6.3.3 Continuous replenishment planning (CRP)

In the early 1990s, a growing number of grocery retailers, distributors, brokers and suppliers were concerned that the industry was losing its competitive advantage. Vergin and Barr (1999) indicate that CRP is "the practice of partnering between distribution channel members that changes the traditional process from retailer generated purchase orders based on economic order quantities, to the replenishment by the vendor of product based on actual and forecast data". In the grocery industry, CRP was expected to generate $12 billion. Retailers provided real time access to the point of sales data to their suppliers and as a result the visibility in the chain was raised. Therefore, manufacturers by having access to retailers' point-of-sales data and inventory could generate demand forecast more precisely (Raghunathan & Yeh 2001).

The advantages that derive from CRP are similar to VMI, but it also has unique advantages. Particularly, from the manufacturers' side, demand uncertainty is lower so the level of inventory is decreased. From the retailers' perspective, they reduce the capital investment in inventory while they keep lower stocks. As a result, the carrying costs will be decreased (Raghunathan & Yeh 2001). However, even though CRP provides a better approach for inventory management and replenishment, there is still a lack of visibility in the entire supply chain. It should also be considered that CRP can work effectively in environments where the demand is stable or easily predictable; it cannot be adopted in market places with high volatility (Sherman 1998).

2.6.3.4 Collaboration planning, forecasting and replenishment (CPFR)

Collaborative planning, forecasting and replenishment (CPFR) is a powerful approach to improve the cooperation between trading partners from upstream to the vendor/suppliers and downstream to the customer. A subgroup of Voluntary Inter-industry Communications Standards (VICS) describes CPFR as "a set of business processes that entities in a supply chain can use for collaboration on a number of buyer/seller functions, towards overall efficiency in the supply chain" (Verity 1997). Skjoett-Larsen, Thernøe and Andresen (2003) explain CPFR as: "Collaboration where two or more parties in the supply chain jointly plan a number of promotional activities and work out synchronised forecasts, on the basis of which the production and replenishment processes are determined". Lee (2000) for describing what CPFR means, used collaboration between Wal-Mart and Warner-Lambert as an example which follows:

> "Knowledge exchange is the basis for Wal-Mart's collaboration with Warner-Lambert (now part of Pfizer) on the forecasting and replenishment of pharmaceuticals and health-care products. Retailers such as Wal-Mart usually have the best knowledge of local consumer preferences through their interactions with customers and their possession of point of sale (POS) data. Pharmaceutical companies know about the properties of the drugs they produce and can make use of external data, such as weather forecasts, to help project demand patterns. Both parties contribute their respective knowledge and collaborate closely to determine the right replenishment plan."

Fliedner (2003) cited some the benefits of CPFR based on many pilot studies:

Retailer benefits:

- increased sales;
- higher service levels (in-stock levels);
- faster order response times;
- lower product inventories, obsolescence, deterioration.

Manufacturer benefits:

- increased sales;
- higher order fill rates;
- lower product inventories;
- faster cycle times;
- reduced capacity requirements.

Shared supply chain benefits:

- direct material flows (reduced number of stocking points);
- improved forecast accuracy;
- lower system expenses.

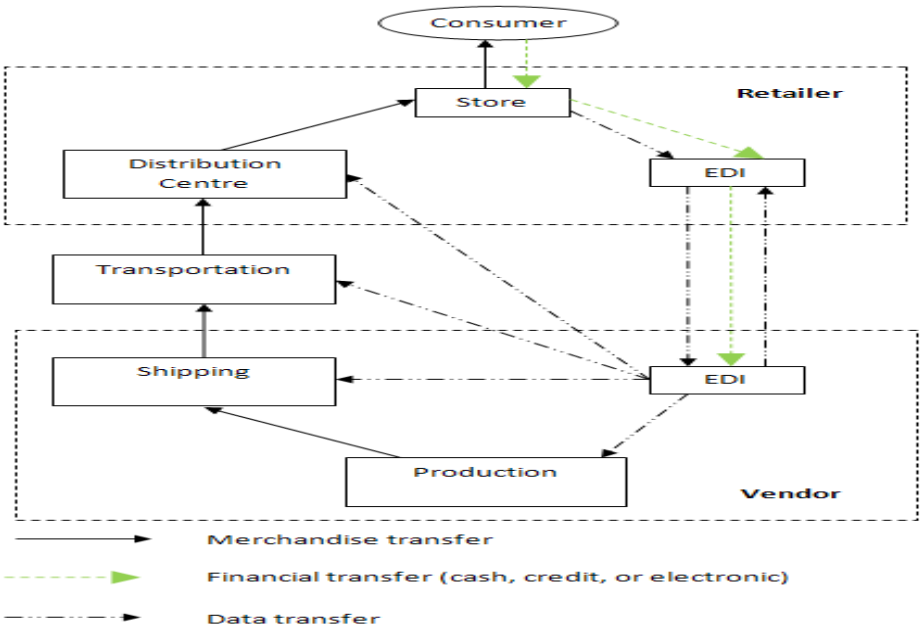
For instance, the pilot study carried out in Nabisco/Wegmans Foods revealed a supply chain sales increase of 36 to 50 percent through a more efficient deployment of inventory (Lewis 2000; Loudin 1999). KPMG consulting conducted a survey of both retailers and manufacturers in 1998 regarding the frequency and the benefits derived from information exchange (Fliedner 2003). Manufacturers mentioned major improvements in cycle time and inventory turns. Retailers cited that order response times as short as six days for domestic durables and 14 days for non-durables were being achieved. Four out of ten respondents indicated a minimum of 10 percent improvement in both response times and inventory turns, while 45 percent mentioned reductions of at least 10 percent in associated costs.

2.6.3.5 Quick response (QR)

Quick response entails online electronic linkages of sales data from retailers to merchandise vendors (suppliers), with the vendors rapidly supplying retailers with the merchandise required to return the inventory in stores to levels formerly determined cooperatively by the retailer and the supplier (Birtwistle, Siddiqui & Fiorito 2003). Figure 2.5 depicts a typical

flow of merchandise, data and monies in a quick response partnership between a retailer and a vendor.

Figure 2.5: Merchandise, data and financial transfer with quick response



Source: Fiorito, May & Straughn (1995)

Consumers begin the QR process by communicating their requirements to the store through their purchases. All merchandise information, for example, size, colour, style and brand, are collected through scanning barcodes (Birtwistle, Siddiqui & Fiorito 2003). This information is sent to the supplier (e.g. manufacturer) by EDI rather than the typical process of remitting a purchase order. This sales information is compared with the inventory model for the store. Production is ordered for the specific items required to restore the inventory to the model's requirements. Notification of the expected shipping data is sent out to the shipper and the retailer (Fiorito, May & Straughn 1995).

Production orders are sent out to the plant where the goods are produced. The product is packed and shipped to the retailer. The cycle is complete when the product arrives at the store. The linkages to effect QR need broad changes in working relationships among retailers and suppliers, as well as system changes in the links in the chain of distribution from manufacturers to consumers (Fiorito, May & Straughn 1995).

2.7 Information sharing

Increasing the level of integration and information sharing between the members of a supply chain has become a necessity for improving effectiveness (Sezen 2008). According to the Global Logistics Research Team (Bowersox, Calantone, Clinton, Closs, Cooper, Droge, Fawcett, Frankel, Frayer & Morash 1995), information sharing is "the willingness to exchange key technical, financial, operational and strategic data". The shared information should be in a form that is usable and meaningful to other parties, otherwise it will not make any difference to the supply chain's processes (Handfield & Nichols Jr 2002; Mason-Jones & Towill 1997). In other words, inter-organisational information sharing (information integration) involves the sharing of information across firms' boundaries and is required in order that firms involved in such relationships can compete effectively in their environment (Forrester 1958, Lee & Whang 2003; Yuchtman & Seashore 1967). Knowledge, an intangible resource, has been identified as the most essential competitive asset that a firm possesses (Grant 1996). Information is tied with knowledge in a complex way, which becomes an asset when it is shared and thereby provides competitive advantage to organisational networks. Lee & Whang (2000) indicate that information sharing involves sharing of any type of data (information) that could influence the actions and performance of the other supply chain members.

The concepts of data, information and knowledge are interrelated. Kumar and Thondikulam (2006) clarify that knowledge cannot be effectively achieved without considering its media that is data and information. Through data, knowledge and information can be stored and transferred. A piece of data, then again, only becomes information or knowledge when its receiver interprets it. Knowledge and information flow in organisations is the form of data transfer through media such as instructions, drawings, minutes of meetings, records, electronic files or web pages (Kumar & Thondikulam 2006). Data can be defined as facts (Pollock & Hodgson 2004) and information is data which has been given meaning or data whose form and content are proper for a particular use (Alter 1995). Information is also known as data which is of potential value in decision making (Small & Sage 2006). Compared to information, knowledge is more difficult to detach, transfer and share, and harder to assimilate and understand (Brown & Duguid 2002). Miller and Morris (2008) consider knowledge as the junction of information, experience and theory. One approach to distinguish data, information and knowledge is to view them as a value chain: information

has more value than data, and knowledge possesses more value than either data or information (Desouza & Awazu 2004). Lee and Whang (2000) discuss information types that are common for information sharing in supply chains, as presented below.

- *Inventory levels:* Inventory levels are one of the most common types of information that is shared between actors in supply chains. Many researchers discussed this type of data which is closely related to the bullwhip effect, and therefore much research is being done in order to explain the effects of sharing information about inventory levels. It can be argued that inventory and communication can be used in place of each other and that access to information about inventory levels can lower the total amount of inventory in the supply chain (Chen, Drezner, Ryan & Simchi-Levi 2000).

- *Sales data:* In the traditional supplier-customer relationship, companies communicate demand information exclusively in the form of orders. Indeed, orders from downstream serve as a critical source of information about future businesses. But if the supplier depends solely on orders for future production planning, problems arise. Since orders are 'processed' as a result of various information and conjectures by the buyer, data regarding orders often distort the true dynamics of the marketplace (Lee, Padmanabhan & Whang 1997b).

- *Order status for tracking/tracing:* Since a typical supply chain involves many different functions and independent actors, it can be difficult to track and trace an order and check its status. As a result, it is difficult, for instance, for a customer to find out the status of an order, since the end customer does not always know who else besides the retailer is involved or where in the supply chain the order is being processed. Lee and Whang (2000) suggest that in practice these problems can be reduced by linked web sites or access to each other's databases.

- *Sales forecast:* In recent years, the sharing of sales forecasts and its impact on firm performance (Smaros, Lehtonen, Appelqvist & Holmstrom 2003) has been highlighted in the literature. In fact, other actors in the supply chain may have better knowledge to make better, more accurate, forecasts. A common type of forecast sharing is when supply chain actors share their forecasts with their upstream suppliers in the SC. In these cases, it seems that the companies closer to the end customer will have better knowledge and hence make a better

judgment of future demand. For example, Lee and Whang (2000) in their research mentioned Warner-Lambert, a pharmaceutical manufacturer, which is considered to have better knowledge about end customer demand than the retailers because of their in-depth knowledge about how weather conditions influence the sales of their pharmaceutical products. Therefore, Warner-Lambert is able to make accurate forecasts based on weather reports.

- *Production/delivery schedule:* Another type of information that can have great impact on supply chain performance is related to production and delivery schedules. When a supplier shares this type of information, the customer's manufacturing processes can be improved because of better planning possibilities (Lee & Whang 2000). Other information often shared consists of performance metrics and capacity. Performance metrics is related to product quality data, lead times, queuing delays at workstations and service performance. Sharing this kind of information can help in recognising the bottlenecks of the chain and improve overall performance (Lee & Whang 2000; Uusipaavalniemi & Juga 2009). Sharing capacity information can lead to mitigating potential shortage gaming behaviour and assist the downstream supply chain partners to better coordinate and prepare against possible shortages.

Uusipaavalniemi (2009) classified the characteristics of information to be shared in a supply chain into form, availability and quality. Form is related to the mode and medium in which the information is delivered to its user or through which it is made available (Ahituv 1989; Freiden, Goldsmith, Takacs & Hofacker 1998). Therefore, it is about how the information is distributed and how it can be accessed. The form of information can be explained through four categories (Uusipaavalniemi & Juga 2009):

- Data and information in databases: Information stored in information systems and local databases;
- Documents provided electronically: Information stored locally or on shared network drives and shared by e-mail;
- Paper-based documents*:* Information exchanged by fax, mail or personal hand-over;
- Informally shared information: Information shared through informal contacts with other employees, i.e. via telephone, meetings, e-mails and conversations.

Four common aspects of information quality are accuracy, usefulness, reliability and completeness (Hsu et al. 2008; Li & Lin 2006; Mohr & Sohi 1995; Uusipaavalniemi & Juga

2009). Information accuracy describes the degree of conformity of the received information compared to its actual content; put differently, whether the information is without error or not. Accurate information conforms to the real characteristics of the phenomena that it intends to describe (Freiden et al. 1998). Inaccurate information can be misleading or injurious to its users. Usefulness (or utility) of information indicates usefulness for a certain purpose. The mode and format of the information is such that it can be applied easily in everyday use without any particular skills or tools (Parker 1998). Reliability of information is the likelihood that information is correct. This can be classified into reliability of content and reliability of source (Meadow & Yuan 1997). Reliability of content is very close to the accuracy concept. Evaluating the reliability of a researcher or corporate source of information might be done by ranking the earlier content reliability of information from the source or the situations under which a particular message oriented (Meadow & Yuan 1997). Completeness describes how complete and inclusive the information about the subject on hand is or how many percentages of the target phenomenon is explained by the information available. Incomplete information may be entirely useless or have decreased value to the users (Freiden et al. 1998).

The information availability can be described as how often the information is available in the right time. Parker (1998) defines availability as the usability of information for a purpose. This guarantees that information and critical services are available to users when required. For example, Gustin, Daugherty and Stank (1995) emphasise that high levels of information availability are connected to successful implementation of integrated distribution concepts. Information availability can lead to proper decision making at the strategic, tactical and operational levels. Integrated firms tend to place more importance on providing information support for management and control functions (Gustin, Daugherty & Stank 1995).

Early research by Byrne and Javad (1992), Gustin, Daugherty and Stank (1994), Daugherty, Myers and Autry (1999) and Stevens (1989) acknowledged the benefits of information sharing. They take a holistic view of SC and imply that each member within the SC should coordinate operations through total information sharing with the aim of accomplishing overall system objectives. Nevertheless, at that time (late 1980s to mid-1990s), the infrastructure and technical capability for sharing information was limited (Shore & Venkatachalam 2003). This can be the possible reason why academics and researchers were

not able at the time to examine their hypotheses empirically and build a comprehensive argument. Bowersox and Closs (1996), as an example, discuss the benefits of information sharing but they were not successful in determining the problems and complexities involved. With the emergence of IT and particularly e-business, the capabilities and benefits discussed by these researchers can now be empirically tested.

Frequent communication and interaction have been argued as an important mechanism in efficient management of information flow (Barratt 2004; Bowersox, Closs & Stank 2000). Communication methods are the enabling technologies for sharing information (Sahin & Robinson 2002). Carr and Kaynak (2007) separate the communication methods into traditional methods (telephone, fax, e-mail, written communication and face-to-face contact) and advanced methods (computer-to-computer links, EDI (electronic data interchange), ERP (enterprise resource planning), etc.). Face-to-face interaction is considered important in buyer-supplier relationships for information sharing, and advanced communication technologies provide additional opportunities to share information (Wognum, Fisscher & Weenink 2002). Advanced communication methods broadens and deepens accessible information about business activity (Bhatt 2000). As the use of IT facilitates communication, it would lead to more frequent interaction among suppliers and buyers (Carr & Smeltzer 2002).

2.7.1 Information standards

As mentioned before, information sharing consists of communication between different actors in the supply chain. Standards are conventions for carriers of information content about goods. These conventions pertaining to communication about goods have an important role in enhancing the comprehensibility of information exchanged among actors. This means efficiency of communication in a supply chain is related to how information content and information carriers are used through documents.

Gadde and Håkansson (2001) argue from the perspective of a purchaser how information standardisation leads to all suppliers being handled in a uniform manner, enhancing the similarity of activities in relation to different suppliers. This affects the efficiency of information sharing, which in turn influences the performance of logistics activities.

Whiteoak (1999) cites a suppliers' perspective of what he calls a "quick response" in the supply chain, and emphasises the importance of information content concerning goods to facilitate rapid replenishment of retailer inventory: "in retail, detail is all." Information sharing for replenishing inventories managed by vendor needs "all the cooperating parties to use similar protocols and common product numbering" (Kaipia & Tanskanen 2003).

A barrier in communications regarding goods is one of the several isolated incompatible units of measurement. This is because measurement activities in SCs are not managed as a solo system, but as many independent systems (Holmberg 2000). A solution for this type of communication interface is a unifying measurement system, and such a system leads to stimulating the integration processes. According to Holmberg (2000), the linkage among planning and actions relating to the flow of goods is based upon "a heavy reliance on financial measures causing reactive behaviour, and confusing multitude of isolated measures." In other words, the use of logistics is planned and later operationalised.

It is argued that one of the important aspects of information sharing for efficiently achieving coordination of logistics resources is that supply chain players efficiently communicate with each other (Chan & Chan 2009; Holmberg 2000). Similar to any human society that requires a common language to communicate, they also need to agree on conventions for communication. This involves the utilisation of a common professional terminology. For instance, the measurement system used in the supply chain that involves also how goods are measured, and thereby may be categorised, influences how information about goods is communicated between actors, which in turn influences the performance of the overall supply chain (Holmberg 2000). A regular measurement system of goods accordingly influences the quality features of information sharing concerning how quickly and accurately information can be communicated.

Within the supply chain, the use of numerical codes is common in documents, including labels and tags attached to packages. The GS1 (GS1 Organisation 2010) standards for coding goods and facilities used in conjunction with goods is prevalent in logistics. A code is a numerical standard and coding information requires the use of a particular form of information storage. Codes assist the translation of information into a form that might be automatically communicated. These numerical codes are better adapted to electronic

information systems than text. This can lead to a reduction in information distortion caused by human interference, by automating information sharing to a higher degree. Codes also assist in making information sharing more manageable, particularly when communication is automated (Heskett, Glaskowsky Jr, Ivie & Glaskowsky 1973).

GS1 is a leading global organisation dedicated to the design and implementation of global standards and solutions to improve the efficiency and visibility of supply and demand chains across sectors and industries. It was formally created in 2005 to consolidate the work of the North American UCC (Uniform Code Council, formed in 1974) and the EAN (European Article Numbering Association, formed in 1977). There are GS1 member organisation offices in 108 countries. The GS1 system of standards is the most widely used supply chain standards system in the world (GS1 Organisation 2010). Some of its major products, services and solutions are GS1 bar-coding number and system (GTIN), GS1 net, GS1 system, GS1 data synchronisation, GS1 electronic product code (EPC) standards for RFID technology, GS1 data-bar and GS1 education and training (GS1 Australia 2010; GS1 Organisation 2010). These products and services are described briefly in Appendix 1.

2.8 Evolution of technology in SCM

Historically, most organisations rarely viewed their suppliers or customers as value-added partners. For example, in many industries, each firm played one supplier against another, in order to get lower prices (Sherer 2005). Most manufacturers focused on mass production to reduce unit production cost as the main operational strategy, with minimum product or process flexibility. New product development was very slow and was mostly based on in-house technology and capacity (Tan 2001). Post World War II, the supply chain was viewed as a set of linear, individualised processes that linked manufacturers, warehouses, wholesalers, retailers and consumers together in the form of a human/paper chain (Ganeshan & Marath 2002).

By the 1960s and 1970s, companies started to see themselves as closely linked functions (e.g. demand planning, supply planning, manufacturing planning and transportation planning) whose joint purpose was to serve their customers (Chou, Tan & Yen 2004). This internal integration was often referred to as material logistics management or materials management (Chandra & Kumar 2000). During this time, SCM innovations such as Material Requirement

Planning (MRP) were developed. The firms which effectively integrated these functions could improve their performance, but some constraints such as customers' or suppliers' unresponsiveness hindered the improvements, preventing firms from instantly responding to market changes.

From the late 1970s to early 1980s, US firms faced very strong competition from Japanese firms. In the automobile industry, Japanese factories utilised Just In Time (JIT) delivery for achieving efficient inventory management so companies like Detroit's Big Three had to find ways to communicate with suppliers effectively. Communication through batch orders and via a standard called EDI was a possible solution at that time (Chou, Tan & Yen 2004; Lummus, Krumwiede & Vokurka 2001). The evolution of SCM continued into the 1990s as firms started to adopt Internet and web technology as a worldwide and less costly way to tie their companies and their business partners together in the supply chain. Many companies now are familiar with buzzwords such as Business to Business (B2B) and Business to Customers (B2C). For instance, with the help of RFID technology the product flows are synchronised with the information flows which means it is now possible to generate automatically and in real-time and from a networked database all the information necessary for e-procurement, e-billing, e-forecasting, e-replenishment, etc. and, thus, enable more efficient B2B e-commerce applications (Lefebvre, Lefebvre, Bendavid, Wamba & Boeck 2006). With the advancement of information technology, the cooperation of business partners will continually improve the effectiveness of SCM. The Gartner Group even gave a C-commerce (collaborative commerce) tag to the emerging business model starting from the year 2000 (Chou, Tan & Yen 2004). Table 2.6 shows the evolution of technology in SCM.

Table 2.6: Evolution of technology in SCM

Stage	Years	Milestone	Lessons learned by firms
Introductory	1960s – 1970s	MRP	Firms are closely linked functions, internal integration will help serve customers better
Growth	Late 1970s – late 1980s	EDI	Just-in-time delivery demands for efficient communications with suppliers
Pre-mature	1990s – present	E-commerce, B2B and B2C	The Internet provides a ubiquitous and cost-efficient way to tie together companies and their business partners in supply chains
Future (mature)	Starting from 2000	C-commerce	Collaboration of business partners will continuously improve supply chain management effectiveness

Source: Chou, Tan & Yen (2004)

2.9 Role of IT in supply chain relationships

The role of IT in managing businesses and particularly in SCM has been shown to derive many opportunities, from direct operational benefits to the creation of strategic advantages. Porter and Millar (1985) believed that IT leads to changes in rules of competition and industry structures, creates competitive advantage and new business outcomes. In the logistics/supply chain management context, Bowersox and Daugherty (1995) mentioned the importance of IT in supporting companies creating strategic advantage through enabling centralised strategic planning with day to day centralised operations. Malone, Yates and

Benjamin (1987) suggest the importance of IT in electronic communication (speed of communication), electronic brokerage (by providing a "lean", automated intermediary for resolving market transactions) and electronic integration (coupling of processes).

Many theoretical papers have determined the value of IT in SCM (Bowersox & Daugherty 1995; Cross 2000; Lee & Whang 2003; Levary 2000; Van Hoek 2001). For instance, Levary (2000) reported that IT in SCM contributes a decrease of inventories, a decrease in cycle time, a minimisation of the bullwhip effect, and improvement in the effectiveness of distribution channels. Although there are a number of research articles providing empirical findings on how IT benefits SCM, usually the results are diminished due to the typically narrow focus of discussion. For instance, the study about evaluating the financial value of EDI in supplier relationships for manufacturer-component products in an automotive industry (Mukhopadhyay, Kekre & Kalathur 1995) or the impact of enterprise resource planning (ERP) on order completion performance during a period of one year after the adoption of the system (McAfee 2002). There are many difficulties in determining how IT benefits SCM on a general level. For instance, Walton and Gupta (1999) in their discussion about the benefits of EDI in SCM reveal that:

- The scale of change varies from small to significant process change to the creation of competitive advantage;
- Some benefits are dyadic (or multilateral), depending on both (or a number of) supply chain parties, and some are individualistic; and
- Benefits depend on where EDI is implemented.

In consequence, the benefits of IT in SCM are manifold, and differ in relation to the adoption methods. Furthermore, the use of IT is directly related to process changes. As such, SCM can be considered as a process change that is enabled or assisted by IT. Therefore, it is difficult to separate the source of the benefit, whether derived from IT, process change or both (Auramo, Kauremaa & Tanskanen 2005).

Owning to enhanced technological capabilities, companies have various choices in IT applications geared towards improving coordination, functional integration and decision making. Selecting the type of IT used by a company mainly specifies the quality and nature of interactions the company has with suppliers, customers and trading partners. Some

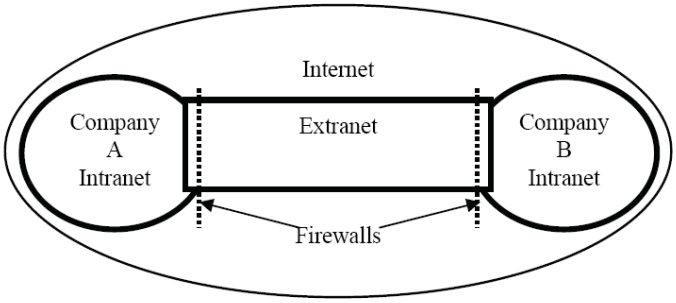
scholars call IT the company's "digital nervous system" (Prahalad & Krishnan 1999). While IT is a critical factor of SCM, it is not a source of value by itself. Rather, the appropriate selection of IT supports and increases the functioning of value added processes. The significance of aligning IT technologies and applications among characteristics of the application and the requirements of the business has always been emphasised in the literature (Malone & Rockart 1995; McFarlan, Jordan & Wurmfeld 1984; Sanders & Premus 2002).

Managers are regularly faced with the challenge of selecting suitable IT applications and setting realistic expectations of performance measures. Therefore, rapid changes in technology, proliferation of software which intends to improve SC functioning, and an abundance of self-proclaimed success stories intensify the difficulty of this selection process (Hayes, Wheelwright & Clark 1988; Sanders & Premus 2002). To remain competitive, organisations are investing vast amounts of money in technologies such as Enterprise Resource Planning (ERP) systems, e-business capabilities and network software. Although it is expensive for corporate-wide applications, major advances in computer hardware, broadband technology and software have made IT solutions possible. Therefore, it is important to understand profiles of companies successfully using these technologies, how these companies compete, the applications they use, and benefits they have achieved. Following are some of the major technologies that have been implemented by organisations in recent years to manage their supply chain activities (Auramo, Aminoff & Punakivi 2002; Kim, Cavusgil & Calantone 2005; Kim, Cavusgil & Calantone 2006; Power 2005; Sanders & Premus 2002; Wu et al. 2006).

2.9.1 Internet and related technologies

Internet is the heart of modern information technology that leverages on computing and communication technologies. Intranet and Extranet are two variants of Internet which are illustrated in figure 2.6.

Figure 2.6: The Internet, the Intranet and the Extranet



Source: Chaffey (2007)

As shown in figure 2.6, both companies A and B are within an Internet environment. The Extranet is carried over the Internet with help of firewalls that limit outsider access (Lin, Huang & Lin 2002). The Extranet is carried over the Internet in the form of a technical relationship investment between companies A and B. Unauthorised access is prevented by firewalls. The Intranet is situated inside a single company and allows that company to communicate and process information (Vlosky, Fontenot & Blalock 2000). This cannot be accessed externally without the company's permission. The Intranet and Internet utilise similar applications (Laudon, Laudon & Filip 2004); the major difference between them is that the Internet is public and open to everyone while the Intranet is usually a private or closed domain that only members, i.e. employees, are allowed to access. Intranets are used for internal information sharing and communications plus internal marketing. Company members can share their notes, policy manuals, product inventories, telephone numbers and other information in a closed and secure environment.

The purpose of using Extranet by a company is to communicate and exchange information with customers, suppliers and other important parties. Vlosky, Fontenot and Blalock (2000) explain that there are many types of definitions of the Intranet, the Internet and the Extranet. They describe the Extranet as "an extended intranet connecting multiple organizations". According to statistics in Finland (Salo 2006), the Intranet and the Extranet have an important role in Finnish companies, since over 70 percent of all enterprises have Intranet and 37 percent use an Extranet.

The World Wide Web is one of the Internet's best liked services, providing access to billions of web pages (Dertouzos & Gates 1997). The three main elements that the web is built on are uniform resource locator (URL), hypertext mark-up language (HTML) and hypertext transfer protocol (HTTP) (Salo 2006). Web pages are created by using HTML and are connected to each other by hyperlinks. The creation of the web brought the Internet to the layman. This development has changed the way in which people use the Internet. Having nicely formatted homepages and corporate web sites are not sufficient. Companies now require enhanced graphics and applications to attract consumers and other businesses to their web sites. Thus, extensible mark-up language (XML) is required. It is a new language for creating software and was created to explain the information and data inside a web page.

HTML is used to demonstrate information, whilst the XML is used to explain the information and data inside the web page or other content. By using XML, it is possible to send extensive documents which might encompass business memos and medical records. However, there are some other options to make the transfer of information easier among organisations, such as standards like RosettaNet. The first electronic business XML (ebXML) was developed for RosettaNet and initiated in 2003. It is a well-known standard for B2B communication and information transfer as it makes many-to-many transmissions possible instead of point-to-point as with standard EDI (Hannula & Vasama 2002).

Now with the help of Internet and the web, it is possible to use search engines to transmit video and music, use e-mail to stream media and to store digital data. Within business relationships these can be regarded as enablers of effective usage and transmission of information. Search engines come in various types and are frequently used as access points to the Internet because they launch some order within the chaos (Dahm 2000). A search engine utilises keywords, for example, queries provided by the user to find the information requested. There are various kinds of search engines that use different types of technologies; for instance, one might read meta-tags whereas another might depend on manual indexing. This describes why one search engine is able to find what a user is looking for whilst another is not. Some search engines are not capable of locating millions of web pages, and are biased towards large corporations that place advertising on other web sites (Dahm 2000).

E-mail is the most accepted service on the Internet. The study by Forrest (1999) revealed that more than 3.5 billion business e-mails and 2.7 billion personal e-mails are sent each day from one user to another in the US. For marketing campaigns, companies use e-mail frequently, but the amount of unwanted mail (spam) sent to customers is continuously rising and this leads to doubt about its effectiveness as an advertising tool. In addition, firms are recognising the advantages of instant messaging (IM) with the help of particular types of software developed for secure IM in a business environment rather than using e-mail. The usage of sound effects and video images in business marketing is increasing as showing a video clip of a product or service makes it easier for the buyer to decrease the risks associated with purchasing a new product or service from the seller. Virtual tours offered by web sites are also very popular tools (Breitenbach & Van Doren 1998; Strauss & Frost 2008).

Video teleconferencing, digital libraries, digital video, distance learning and distributed storage can be used in a novel way owning to the increase in speed, stability and bandwidth. Application of these new technologies is increasing with development of the Internet and reduction of prices of these services and accessories. In digital libraries, the software required by the user can be simply leased. Because of decrease in equipment and access cost, video teleconferencing is readily available. This makes it useful when businesses are engaged in negotiation and when geographical distance between the parties is measured in hundreds of miles (Zwass 2003). Salespeople with the help of digital videoing can present how the product really works or movie companies can transmit their content to user with the help of a third party. A combination of virtual reality and videoconferencing is Tele-immersion where users can see each other and collaborate on visual projects. This assists employees in R&D to build new products in a better way by decreasing costs and improving effectiveness of the department (Zwass 2003). Finally, with the help of XML, use of dynamic web pages is getting simpler, which means the contents are stored as objects in a database, rather than being hard-coded in HTML. Hence, when a user asks for a web page, the contents are obtained from the database. This makes it possible to dynamically change the content. In this way, data of new products, inventory information and promotions details can be updated easily and with fewer errors than was formerly possible. (Salo & Tähtinen 2005).

2.9.2 Electronic data interchange (EDI)

Currently there are different electronic commerce technologies and systems available for business usage. These are designed to enhance productivity and efficiency of processes such as sales, invoicing, planning and manufacturing, but only some are used in inter-organisational relationships. Cash and Konsynski (1985) used an umbrella concept of IOS (inter-organisational system) for these types of systems, describing it as "an automated information system shared by two or more companies". One form of IOS is EDI. Transmissions are achievable between different companies if they have taken up EDI and have integrated the necessary technologies. For sharing business documents (such as invoices, purchase orders, shipping bills, product stocking numbers, stock keeping units (SKUs) and settlement information) between a small number of companies, EDI is a suitable communication standard. Archer and Yuan (2000) suggest that EDI is the "standard protocol to share information among participating companies through computer-to-computer exchange of electronic documents, relating to purchasing, selling, shipping, receiving, inventory, financial, and other activities". An EDI message has various segments inside digital documents such as product purchased, amount, transaction date, sender's name, address and recipient's name. It was created to decrease cost, delays and errors intrinsic in the manual sharing of documents related to logistics and purchasing. It can eliminate the mailing or faxing of papers and, due to the data being processed and stored automatically, tasks such as re-keying data and printing purchase orders and invoices are eliminated (Clarke 1992).

By initiating EDI for first time, business processes were restructured by making the traditional invoice obsolete among trading partners. Processing costs for paper orders were reduced from an average of US$150 to $25 (Verity 1996). Initially this happened only in some large companies, but was later on picked up by many smaller companies. Turban, Lee, King & Chung (2000) determined several reasons why companies do not reap the advantages of EDI, including:

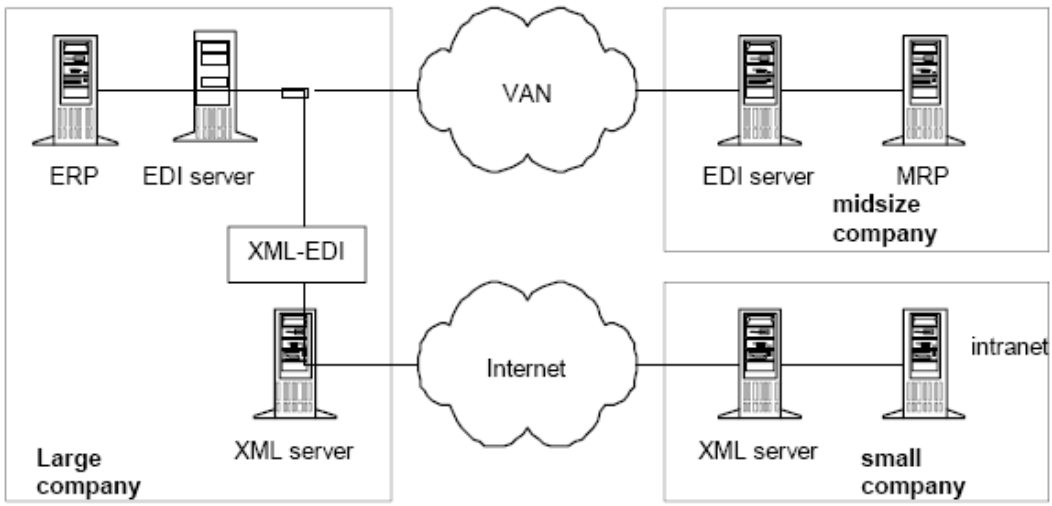
- Significant initial investment;
- Restructuring business processes is necessary to fit EDI requirements;
- High EDI operating cost;
- Use of expensive private VAN is necessary;
- Long start-up time;

- Multiple EDI standards;
- The system is complex to use;
- A converter is required to translate business transactions to EDI code.

Vlosky, Smith and Wilson (1994) propose that there are some major success factors in EDI implementation that should be considered, including joint supplier-buyer pre-planning, communication, coordination and multi-functional involvement within and among exchange partners. Wilson and Vlosky (1998) propose that technologies which connect companies, like EDI, affect short-term disruptions in otherwise stable buyer-supplier relationships owning to non-alignment of exchange partner expectations and perceptions within relationships. Moreover, EDI using private networks is relatively expensive (Tuunainen 1995, 1998).

With the advent of the Internet in EDI systems (EDI-XML), EDI has become more beneficial to companies, especially smaller ones with fewer resources. Angeles (2000) identified the changing nature of relationships between powerful buyer companies and smaller seller companies as EDI-XML lets a broader choice of trading partners for smaller companies and more beneficial trading terms can be established (see figure 2.7). There are various types of Internet-based EDI and other simple software which make it a reasonable solution for many smaller companies (Turban et al. 2000).

Figure 2.7: An EDI-XML trading system



Source: Ricker, Munro & Hopeman (2001)

2.9.3 Enterprise Resource Planning (ERP) systems

By the early 1990s, managers aimed to find new solutions to manage and control their resources effectively. Gartner Group Inc, a consulting company, developed ERP (Stephens & Ramos 2003). This was viewed as a solution to many integration problems (Davenport 1998). ERP originated from the material requirements planning (MRP) approach. MRP is a legacy system that generates a bill of material (BOM) and facilitates companies to forecast, track and manage all constituent parts of complex manufactured goods (Laudon & Traver 2001). The legacy computer system is an older mainframe and/or minicomputer system that manages main business processes within a company in different functional areas (Laudon & Traver 2001). ERP can be viewed as being more sophisticated than MRP as it entails a graphical user interface, relational databases, and advanced computer-assisted software and engineering tools (Hodge 2002; Laudon & Traver 2001).

ERP emphasises the effective use of internal resources, but it soon becomes evident that the phrase 'no business is an island' still applies (Håkansson 1989). New versions of first-generation ERP1 systems and second-generation ERP2 systems hence focus more noticeably on both internal and inter-organisational relationships with customers and suppliers. The ERP system can be acquired in a similar way to other electronic commerce systems from different vendors or developed internally, which consumes considerable resources. There is a comprehensive consolidation trend happening in the ERP software industry, especially in the solutions provider market. For instance, Peoplesoft bought J.D. Edwards, when Oracle initiated a hostile takeover bid for Peoplesoft and obtained the company in 2005. SAP as the largest player stays firmly in the market. In addition, according to the ARC Advisory Group, the global ERP market is predicted to grow in near future (Salo 2006).

The ultimate benefits of using an ERP system are obtained when a customer places an order and it translates the order in BOMs, to production schedules, human resource planning and financial calculations that are all done automatically. According to Laudon and Traver (2001), "ERP systems were not originally designed to coordinate the flow of information between a large set of supplier firms, and they require expensive modification before they can become part of an enterprise-wide business to business system". Older versions can be explained as inward-looking, as they were focused on internal integration, and the idea was to

form an information backbone (Stephens & Ramos 2003). Applications at that time covered a range including processing, finance, purchasing, and manufacturing. Some ERP solutions include basic forecasting functions, warehouse management, business intelligence and electronic commerce functions to a limited extent (Stephens & Ramos 2003).

The current ERP systems in the market include the planning of the entire enterprise, from management reporting to marketing, sales, human resources, plant maintenance, distribution and product development (Freedman 1999). ERP systems are advancing as a result of web-based applications, and they help companies to integrate with suppliers, customers and other trading partners. Currently all the main players such as Oracle and SAP provide software adopters to integrate different vendors' ERP systems with their own ERP system. This means by integrating internally, real-time and high-quality information provides more effective communication with external businesses. The Internet makes it possible to send large amounts of information, providing benefits and cost-savings to both buyers and suppliers. Business relationship integration is achievable when access to all important sources of information is possible as a result of applications of the Internet (Stephens & Ramos 2003).

Thus, many companies have made large investments in existing software and hardware systems and are looking for ways to leverage these investments. Second-generation ERP systems are more focused on value chain participation or enabling collaborative commerce through web-based, open and component-based systems (Bond, Genovese, Miklovic, Wood, Zrimsek & Rayner 2000). The use of modularisation or component-based architecture assists users to roll out new modules rapidly, cost effectively and with small distractions to the business. For instance, ERP2 enables a supplier, by using Vendor Management Inventory (VMI) techniques, to link to factory ERP applications of "buyer/client" company and identify the remaining number of parts still in stock (Gardiner, Hanna & LaTour 2002). It also assists retailers to distinguish their order status and get other information required by utilising a web-based system with secure password protected lines. Furthermore, ERP2 systems can be used via mobile devices, enabling real-time access to company information around the world (Gardiner, Hanna & LaTour 2002).

2.9.4 Radio-frequency identification (RFID)

RFID technology has been recognised as "one of the most pervasive computing technologies in history" (Roberts 2006). This concept is not new, having its origins in military applications during World War II when the British Air Force utilised RFID technology to distinguish allied aircraft from enemy aircraft with radar (Asif & Mandviwalla 2005). RFID technology is categorised as a wireless automatic identification and data capture (AIDC) technology (Swartz 2000). Generally, a RFID system is composed of three layers: a tag including a chip which is embedded in or attached to a physical object to be identified; a reader and its antennas that enable tags to be interrogated and to respond without making contact (in contrast to barcodes, which need a line of sight and should be read one at a time); and a computer equipped with a filters data and interacts with enterprise applications (Asif & Mandviwalla 2005).

By attaching a tag to a product, with an electronic product code (EPC) – a unique product identifier based on standards developed by the EPC global network–stored on it, the product takes on a unique electronic identity. RFID technology makes it possible for physical and information flows to converge to create intelligent physical assets. For instance, when goods are passed into a retail store or distribution centre, they are able to communicate their identity and history to the readers located by the loading bays, and therefore to the systems into which these readers are integrated.

Many retail companies such as Metro, Tesco, Marks & Spencer and Carrefour are currently using RFID tags to help track information on individual products, monitor goods, and check movement and inventory flows (Sullivan 2004). Among manufacturing companies, for example, BMW is tracking cars as they move through the production line (Maselli 2003) and Airbus have initiated the use of RFID to track spare parts (LogicaCMG 2004). Many major IT vendors, such as SAP, Oracle and IBM, have also started to adopt existing solutions to exploit RFID. Viewed collectively, it is clear that there are main developments being undertaken by different categories of powerful actors. This is creating an expectation that there will be widespread adoption of RFID and that it will have a considerable effect on the performance of supply chains (White, Johnson & Wilson 2008).

In the academic community as well, this emerging phenomenon is reflected in different fields of research, for example, innovation management (Sheffi 2004), project management (Bendavid & Bourgault 2005), environmental management (Hilty 2005), e-commerce (Bendavid, Lefebvre, Lefebvre & Wamba 2007; Smith 2005), supply chain management (Lefebvre, Lefebvre, Bendavid, Wamba & Boeck 2005; Srivastava 2004), mobile business (Wamba, Lefebvre, Bendavid, & Lefebvre 2008), information systems (Yang & Jarvenpaa 2006) and decision support systems (Ngai, Cheng, Au & Lai 2007). However, all too frequently, technology promises more noticeable benefits than it can deliver, and information technologies are no exception (Coates 1992).

2.10 Gaps in the literature

Although many scholars believe that IT is fundamental to a firm's survival and growth, many researchers, managers and policy makers still have difficulty in identifying the principal mechanisms linking IT to organisational performance (Bharadwaj 2000; Devaraj, Krajewski & Wei 2007; Melville, Kraemer & Gurbaxani 2004; Powell & Dent-Micallef 1997). Anecdotal evidence and case studies indicate that its effective and efficient use is an important factor differentiating successful firms from their less successful counterparts (Byrd & Marshall 1997; Davenport & Short 1990; Hammer 1990; Venkatraman 1994). Despite evidence from many case studies that IT enhances productivity and performance (Davenport & Short 1990; Hammer & Champy 1993; Soh & Markus 1995; Venkatraman 1994), practical evidence from large sample research has not been as readily forthcoming. Indeed, many studies have indicated that, in some cases, IT investment has had negative dysfunctional effects on organisational productivity and performance (Brynjolfsson & Hitt 1994; Roach 1991). There is also evidence that several firms, concerned about falling behind on the technology curve, invest heavily in IT capabilities without deriving any benefits (Nolan 1994). Thus, regardless of substantial investment in IT, direct linkage between technology usage and enhancement in productivity and performance has been extremely elusive.

IT productivity paradox is a well-known concept which has been discussed by many scholars in relation to the impact of IT on organisational performance, particularly in the SCM context (Auramo, Aminoff & Punakivi 2002; Auramo, Kauremaa & Tanskanen 2005; Blankley 2008; Byrd & Davidson 2003; Devaraj, Krajewski & Wei 2007; Jean 2007; Kim, Cavusgil & Calantone 2005; Kim, Cavusgil & Calantone 2006; Sanders 2007, 2008; Setia, Vickery,

Dro¨ge, & Sambamurthy 2007; Wu et al. 2006; Zhu & Kraemer 2003, 2005). This paradox draws attention to the fact that IT does not necessarily increase productivity or business performance; indeed, IT can even be viewed as a commodity which can be easily be replicated by competitors (Carr 2003) and therefore reduces the prospects of developing sustainable competitive advantage. For instance, macroeconomic studies in the US acknowledged that even with growing IT investment, overall productivity statistics showed poor performance (Auramo, Kauremaa & Tanskanen 2005). Devaraj and Kohli (2003) argued that the conceptual problem relating to the productivity paradox is that in many studies only IT investment, not actual usage, is considered. They showed how observed use was positively and statistically significantly related to revenue and quality improvements with a specified time lag, while investment in IT, as such, with the same data, was not.

The number of studies about the impact of IT on supply chain relationships and performance are increasing in different disciplines such as in marketing (Kim, Cavusgil & Calantone 2006), supply chain (Sanders 2005), information system (IS) (Rai, Patnayakuni & Seth 2006) and strategy (Kim & Mahoney 2006). Empirical evidence is still fragmented and a comprehensive conceptual framework to integrate theoretical perspectives is lacking in the literature (Gunasekaran & Ngai 2004; Jean, Sinkovics & Kim 2008). In particular, there is lack of academic investigation on how and why IT can improve the management of firms' supply chain channel relationships and consequently lead to performance gains.

For example, the literature has discussed extensively the use of EDI as a traditional inter-organisational information system that mediates buyer-supplier transactions (Chatfield & Yetton 2000; Vijayasarathy & Robey 1997). In the automobile industry, some studies identified its economic value such as reduced costs of carrying inventory, obsolescence and transportation through more accurate and timely information exchange (Chatfield & Yetton 2000; Mukhopadhyay & Kekre 2002). Nevertheless, EDI is not always directly and positively related to value creation in the supply chain context (Benjamin, De Long & Scott Morton 1990; Naude, Holland & Sudbury 2000) and furthermore, its proliferation is comparatively narrow and typically limited to large organisations, as these technologies are very complex and require a high level of customisation (Zhu, Kraemer, Gurbaxani & Xu 2006). Many companies are utilising the Internet to do business in their supply chain (Lancioni, Smith & Oliva 2000). It has led to increased use of traditional EDI systems by making them flexible and lowering transaction costs (Garcia-Dastugue & Lambert 2003; Zhu et al. 2006).

Therefore, more firms have gone beyond the limits of traditional EDI and adopted more Internet enabled inter-organisational information technologies such as XML in conducting their supply chain activities (Zhu et al. 2006). However confirmation of the benefits of these emergent technologies is quite scant and mostly relies on case studies and anecdotal evidence (Garcia-Dastugue & Lambert 2003; Lancioni, Schau & Smith 2003). Another study in this area advocates that the Internet increases the relationship between network orientation and supply chain management but a review of the literature shows mixed results concerning the performance outcome of IT usage in supply chain management, both in the context of EDI application and the Internet (Devaraj, Krajewski & Wei 2007; Kim & Mahoney 2006). In order to solve the current ambiguity and lack of consensus in the literature regarding the business value of IT in SC relationships, some major factors should be considered.

Firstly, there is no consensus pertaining to the dimensions of IT adoptions and IT capabilities in the supply chain relationships and performance literature. Researchers use different terminologies for inter-organisational technologies like Internet and EDI, and different measurements such as EDI volume, depth, diversity, breadth and embeddedness for their contributions towards enhanced performance (Massetti & Zmud 1996; Mukhopadhyay, Kekre & Kalathur 1995). Recent studies in the marketing, operation management and information systems, driven by the resource based view (RBV) theory, have discussed different IT resources and capabilities and their performance outcomes. As shown in table 2.7, some studies adopted electronic or virtual integration as a key IT resource. Kim, Cavusgil & Calantone (2006) conceptualise inter-firm systems integration, applied technological innovation, and administrative innovation as three main IT resources.

Table 2.7: Some recent studies on key IT capabilities in the supply chain context

Studies and Authors	IT related resources and capabilities
Wang, Tai & Wei (2006), Kim & Umanath (2005), Kim & Mahoney (2006), Kim et al. (2006), Jean (2007)	Electronic integration
Rai, Patnayakuni & Seth (2006)	IT infrastructure integration
Sanders (2005), Wu et al. (2006)	IT alignment
Kim, Umanath & Kim (2006)	Electronic coordination, electronic monitoring
Kim, Cavusgil & Calantone (2005), Kim et al. (2006), Wu et al. (2006)	IT advancement
Mckone-Sweet & Taek Lee (2009)	Exploitation, exploration

Source: Jean, Sinkovics & Kim (2008)

As shown in table 2.7, leading researchers conceptualise and use different terms for IT related resources and capabilities. For example, Arun and his colleagues (2006 cited in Jean et al. 2008) conceptualised IT integration capability as a main IT resource which impacts on supply chain process integration and firm performance.

Secondly, many IT business value studies have ignored the synergistic effects of IT with other organisational factors, such as business strategies, top management support and human related IT. IT does not operate in a vacuum; it works very closely with other organisational assets (Andersen & Segars 2001; Byrd & Davidson 2003; Kearns & Lederer 2000; Li & Richard Ye 1999). For example, many studies investigated the impact of IT infrastructure (related to its usage, connectivity, transaction and diversity) (Chen & Hsiao 2008; Rai, Patnayakuni & Seth 2006; Sanders 2007; Sanders & Premus 2002, 2005; Wu et al. 2006; Zhu & Kraemer 2003) without considering the role of people (human IT resources, e.g. their knowledge and skills) as one of the critical factors for successful adoption and implementation of these inter-organisational technologies (Bharadwaj 2000; Hadaya 2008; Kim, Cavusgil & Calantone 2006; Powell & Dent-Micallef 1997; Power 2005). Customer orientation, IT integration (IT strategic planning), top management support and supplier relationships are some of the key IT organisational resources which are widely cited in the literature (Bharadwaj 2000; Byrd & Davidson 2003; Jean, Sinkovics & Kim 2008; Melville, Kraemer & Gurbaxani 2004; Powell & Dent-Micallef 1997; Wu, Mahajan & Balasubramanian 2003; Yao, Palmer & Dresner 2007). There is no strong evidence as to how

different IT resources interact with each other and with other capabilities and business processes to create competitive advantage (Jean 2007).

Finally, research pertaining to IT-mediated supply chain relationships and performance, centres around the direct or indirect relation argument between IT and performance. One of the ways to know how IT improves business performance is the emergent process-oriented approach (Pavlou & El Sawy 2006; Ray, Muhanna & Barney 2005). This shows that IT improves business performance through enhanced business processes, capabilities or structures. Most of these studies are driven by the application of the RBV theory in IT business value investigation (Hulland & Wade 2004; Melville, Kraemer & Gurbaxani 2004) which suggest that IT by itself cannot directly lead to enhanced business performance, but should interact with certain higher order organisational capabilities or business processes. Table 2.8 depicts recent studies on key business processes which mediate IT business value in the supply chain context.

Table 2.8: Recent studies on main business processes which meditate IT-business value in the supply chain context

Studies and authors	Mediators in IT-B2B business value
Rai, Patnayakuni & Seth (2006)	Supply chain process integration including information flow, physical flow, financial flow integration
Kim et al. (2006), Wu et al. (2006)	Information exchange, coordination and responsiveness
Gallivan & Depledge (2003)	Control and trust
Sanders (2005), Vickery et al. (2003)	Supply chain integration
Wang, Tai & Wei (2006)	Manufacturer flexibility and supplier responsiveness
Malhotra, Gosain & El Sawy (2005)	Absorptive capability
Kim & Umanath (2005)	Firm coordination, partner coordination
Sanders (2007)	Operational coordination, strategic coordination
Bensaou (1997), Myhr & Spekman (2005), Lee, Pak & Lee (2003), Sanders (2008)	Cooperation (collaboration)
Mckone-Sweet and Taek Lee (2009)	Coordination, planning, supplier and customer involvement

Source: Jean, Sinkovics & Kim (2008)

Subramani (2004) examines a model which investigates supplier benefits obtained from IT in supply chain relationships. Companies' relationship-specific investments had an essentially mediating role between patterns of IT appropriations and firm performance. Supply chain integration and dimensions such as coordination and collaboration have also been treated as important business processes which may mediate the impact of IT on supply chain performance (Kim, Cavusgil & Calantone 2005; Sanders 2007).

The aim of this study is to conceptualise and investigate the issues related to business value of IT in SC relationships. Although some prior research has demonstrated that IT usage does have beneficial performance and productivity impacts, theoretical frameworks are yet to explain whether and how these usages enhance firm performance and create competitive advantage. Thus, the objective of this thesis is to extend current knowledge on whether and how IT usage in supply chain relationships can create firm' competitive advantage and enhance firm performance. In order to develop the research conceptual model, it is necessary to illustrate the key theories applied by previous studies in relation to this field.

Thus, the present research seeks answers for the following specific questions:

1. Whether and how the IT capabilities interact with supply chain channel capabilities create competitive advantage?

2. Whether and how the IT capabilities interact with supply chain channel capabilities enhance firm performance?

2.11 Underpinning theories in this field

It is generally accepted by many scholars (Burgess, Singh & Koroglu 2006; Kuhn 1970; Popper 1961; Wacker 1998) that using appropriate theory is a crucial prerequisite for the appropriate development of any field. However, the theory building process is debatable. Some authors propose that theories should be built upon existing ones (Pfeffer 1995). Others argue that, in the spirit of plurality, new innovative theories should be encouraged (Van Maanen 1995). Broadly speaking, scholars determine a theory as consisting of four main components: definitions of terms and variables; a domain where the theory applies; a set of relationships of variables; and specific predictions (factual claims) (Bunge 1967; Hunt 1991; Reynolds 1971). Theories carefully describe the specific definitions in a precise domain to

clarify why and how the relationships are logically tied in order that the theory gives precise predictions.

Thus, the precision of good theory causes all main components of a theory to be exact, or according to Poole and Van de Van (1989) and Van de Ven (1989), “a good theory is, by definition, a limited and fairly precise picture”. Its precision and limitations can be distinguished in the domain of the theory, the definitions of terms, the explanation of relationships and the definite predictions. Scholars generally agree that the aim of “good” theory is clarification of how and why specific relationships lead to specific events. Other scholars point out the significance of relation building; for instance, Sutherland (Wacker 1998) suggested that theory is an ordered set of assertions about a generic behavior or structure understood to hold all through a significantly broad range of specific instances.

Theory is defined by many scholars as a statement of relationships among units observed or approximated in the empirical world. Approximated units mean constructs which cannot be observed directly by their very nature. Thus a theory can be viewed as a system of variables and constructs in which the constructs are related to each other by propositions and the variables are related to each other by hypotheses (Bacharach 1989). These statements can point out the significance of relationship building in clarifying how and why specific phenomena will occur. Sometimes how and why and specific predictions are condensed into the term “adequate explanation” which implies that, except when a clarification can predict, it is not considered adequate (Hunt 1991).

It is important in a theory definition that researchers be able to exactly specify a theory. This means the main aim of a theory is to answer the questions of how, when, where and why, which is different from the aim of description which is to answer the question of what or who (Bacharach 1989). In brief, any definition of theory should answer common questions that researchers face. First, theory should identify all variables by answering the common questions of what and who. The domain specifies the conditions where the theory is expected to hold true by using the general questions of when and where. The relationship-building stage indicates the reasoning by clarifying how and why variables are related. And finally, the predictive claims specify the questions of “could a specific event occur?”, “should a specific event occur?” and “would a specific event occur?”. From the pragmatic perspective of

managers, the predictive claims from theory answer the could, should and would questions which are relatively important for future success. Therefore, these questions are crucial for theory to be considered useful to managers.

There is a paucity of theories in the field of SCM where it seems development has been mainly practitioner-led, with theory following (Voss, Tsikriktsis & Frohlich 2002). As with any review of relevant literature, the following discussion does not attempt to present an exhaustive explanation of the theoretical underpinnings of SCM. Rather, it discusses and illustrates those theories that are relevant within the context of this research.

2.11.1 Transaction cost economic (TCE) theory

TCE theory was originally developed by Coase (1937) to describe the existence of firms and how integration impacted costs and benefits. His conceptualisation is different from the neoclassical economists' view which sees a firm as a production function in which markets were frictionless and information costless. Instead, he believed that there are costs related to the price mechanism and that these "transaction costs" made organising activities within the firm a more efficient choice. Costs encompass those due to performing safeguarding, adaptation and evaluation of activities.

This theory was extended by Williamson (1975, 1985, 1991) to predict governance structures based on efficiency considerations. Williamson (1991) stated in relation to the discriminating alignment hypothesis that "transactions which differ in their attributes are aligned with governance structures, which differ in their costs and competencies" in a manner that minimises transaction costs. Noticeably, there are logical economic reasons for deciding on how transactions are governed. Three attributes of a transaction - asset specificity, uncertainty and transaction frequency-determine the choice of the appropriate governance structure. Asset specificity is regarded as one of the most important attributes influencing governance structure (Grossman & Hart 1986; Williamson 1979). It is predicted that transactions or exchange entail high asset specificity, uncertain conditions, recur frequently and will be internalised within a hierarchical governance structure. On the other hand, exchanges or transactions that entail low asset specificity, stable conditions and are non-repetitive will be

more aligned with a market governance structure. Hybrid structures are suggested as these attributes are present to a moderate degree.

TCE has been used widely to study inter-firm relationships (Balakrishnan & Koza 1993; Dyer & Chu 2003; Heide & John 1990; Jeffrey & Salancik 1978). Coordination costs and transaction risks are two main components of transaction costs (Clemons & Row 1993). The costs related to sharing information and using that information in decision processes are denoted as coordination costs. These have been referred to as information costs as well (Choudhury & Sampler 1997). Transaction risks take place when the behaviour of transacting parties ex- post (actual) is not in keeping with ex- ante (predicted, forecast) agreements. The possibility of these risks rises when there is information asymmetry.

As noted by Amit and Zott (2001), companies may adopt IT to lower transaction costs and improve information flows, thereby facilitating improved planning and more coordinated actions to reduce uncertainty. Pant and Hsu (1996) suggested how B2B e-commerce can help in reducing transaction costs associated with asset specificity. For instance, companies involved in e-commerce see their suppliers more as collaborators who have similar information systems. Hence, companies are likely to move from a large number of suppliers to a smaller number, losing some of their bargaining power but gaining better standardisation and enhanced collaboration, therefore reducing the asset specific transaction costs (McIvor & Humphreys 2004).

As mentioned earlier, three attributes of a transaction are asset specificity, uncertainty and transaction frequency which are explained in detail as follows:

2.11.1.1 Asset specificity

According to Lonsdale (2008), asset specificity is the degree to which investments made to support a particular transaction (idiosyncratic investments) have a higher value than if they were switched to alternative transactions. Choudhury and Sampler (1997) classified asset specificity into seven categories: information specificity, which is “the extent to which the value of information is restricted to its use and/or acquisition by specific individuals (knowledge specificity) or during specific time periods (time specificity)”; physical assets

such as customised parts needed to produce an item; dedicated assets, which are separate investments made solely to facilitate the request of one customer; human assets attributed to learning by doing; brand name capital; temporal; and sites in which, for example, a physical plant is located in close proximity to a raw material source in order to reduce inventory and shipping costs.

When asset specificity increases it causes bilateral dependency, and with it requires more coordinated responses to any disturbance, but disagreements and self-interested bargaining exclude timely and simple responses leading to inadequate adoption costs (Williamson 1991). This can happen, for example, when conditions change, and requests for adaptation by one party in a dyadic relationship are met with unreasonable demands by the other party who recognises that the partner is locked-in to the arrangement owing to high switching costs (Rindfleisch & Heide 1997; Williamson 1996). Parties can institute measures ex-ante to prevent one party from behaving opportunistically, but these incur safeguarding costs. Instead, if all parties to the relationship invest in particular assets, there is little motivation for opportunism due to the existence of reciprocal dependence (Dyer 1996).

2.11.1.2 Uncertainty

External and internal conditions create uncertainty that can affect how transactions are conducted between parties. Some of this uncertainty relates to external "disturbances" and therefore a distinction is made between environmental or external uncertainty, organisational uncertainty and strategic uncertainty (Williamson 1985; Williamson, Schmalensee & Willig 1989). Environmental uncertainty, which is external to the relationship, is affected by lack of ability to anticipate ex- ante the exchange conditions that occur from random acts of nature. This causes adoption issues and increased transaction costs, due to the problems related with modifications to existing agreements as environmental conditions change. On the other hand, both organisational uncertainty and strategic (or behavioural) uncertainty are internal to the relationship. Organisational uncertainty happens when there is asymmetric information among decision makers and communication does not flow in a timely manner. This is due to the limited information capacity and bounded rationality of decision makers. Whilst there is strategic misrepresentation, nondisclosure, disguise or distortion of information, strategic uncertainty happens (Williamson, Schmalensee & Willig 1989) which leads to the inability to

monitor ex-post behaviour of transacting parties, creating performance evaluation difficulties. A mixture of uncertainty and opportunism can cause information impactedness, i.e. transacting parties have asymmetric information and there are high costs related with providing the same level of information to all parties. Only when there is asset specificity, the impact that uncertainty has on the choice of governance structure can be relevant (Rindfleisch & Heide 1997).

Market governance becomes less desirable due to the high bargaining and inadequate adoption costs, therefore rendering hybrid and hierarchical governance structures more appropriate, when uncertainty increases (Williamson 1985). However, as uncertainty reaches a high level, the midrange of asset specificity (where hybrid governance is the greatest choice) diminishes and may finally disappear. This leads to the necessity for mutual agreement in the case of hybrid adoptions as opposed to unilaterally (with market governance) or by fiat for hierarchy (Williamson 1991). Thus, in situations of high uncertainty both hierarchical and market governance are greater alternatives than hybrid governance.

The results from studies examining the role of environmental uncertainty on governance are unclear. Some reveal that in certain circumstances environmental uncertainty enhances the possibility that companies will vertically integrate (Walker & Weber 1987) while others point out that it can reduce the possibility (Harrigan 1986). Most of these discrepancies have been a result of how the environmental uncertainty construct is operationalised in empirical studies (Rindfleisch & Heide 1997). In contrast, internal uncertainty is not subject to these ambiguities and has been supported in many empirical studies.

2.11.1.3 Transaction frequency

Transaction frequency is one of the three attributes of transaction, related to the rate of recurrence for transactions among particular parties. The importance of transaction frequency on the choice of governance structure relies on asset specificity (Williamson 1985). Hierarchy is more efficient when transactions are frequent and need highly specified assets. With recurrent transactions, the transfer of tacit knowledge is increased (Jones, Hesterly & Borgatti 1997; Williamson 1991) and parties are less able “to seek a narrow advantage in any

particular transaction" (Williamson 1985). Conversely, the preference is for market governance when transactions happen uncommonly or when they happen frequently but asset specificity is low. In the latter case, continuous attention and the bureaucratic costs connected to hierarchical governance are avoidable (Williamson 1975). Bounded rationality and opportunism are two noticeable behaviours which contribute to the preference for exchange transactions happening in hierarchies rather than in companies with conditions of high asset specificity, uncertainty and recurring transactions (Williamson 1975, 1985).

- **Bounded rationality**

Humans in general have limitations to their cognitive and computational ability that prevent them from arriving at the optimal decision in most situations, although their best intention is to behave rationally (Simon 1950). Due to this bounded rationality, which is natural in humans, it is more problematic for companies to negotiate contracts that are truly inclusive as not only are the outcomes vague, but the difficulty entailed makes it virtually impossible to specify all eventualities ex- ante (Williamson 1975). The suitable approach for dealing with these limitations, in relation to the contracts between a buyer and supplier, is firstly to encompass clauses that let them renegotiate in the event that conditions are different than those that existed when the contract was initially signed, and secondly to make them open-ended enough to assist interpretations that are relevant to the existing situations. Under these conditions, the best option is to internalise transactions within the company, therefore eliminating the requirement for complex contracts and the related bargaining costs to arrive at consensus (Simon 1950; Williamson 1975).

- **Opportunism**

Opportunism is one the main principals of TCE theory, which is described by Williamson as "self interest seeking with guile" (Williamson 1985). It entails the "propensity for mutually reliant parties to mislead, distort, disguise, obfuscate or otherwise confuse" for purposes of wealth expropriation. Nevertheless not essentially true for all individuals, opportunistic behaviour is very costly to recognise ex-ante. TCE assumes its existence and proposes that companies protect themselves against its possible occurrence in their interactions with other companies (Williamson 1985).

When all transacting parties do not have access to the private information which is only possessed by some, opportunistic behaviour can occur. This information asymmetry can be revealed either ex- ante (adverse selection) or ex- post (moral hazard) the transaction. Such opportunistic behaviour by one party, which sometimes happens in a buyer-supplier relationship, decreases the motivation to share information and to fully commit to that relationship. Therefore, it is very difficult to coordinate activities and to reap the performance benefits of joint cooperative effort (Jap 2001).

2.11.2 Resource based view theory

The resource based view (RBV) theory originates from Porter's industrial economics models (1998) and seeks to propose clarifications for why firms succeed (Olavarrieta & Ellinger 1997). By focusing on different phenomena, he represents a somewhat complementary option to some of the other theories of the firm, for instance, Transaction Cost Economic (TCE) (Williamson 1975). As mentioned earlier, TCE theory views competition based on the costs of competing in the market place. On the other hand, RBV views the priorities of companies by competing through the competencies and capabilities that they have at their disposal. Although it may appear that these approaches contradict each other, this is clearly not the case. It would be difficult to see how one could exist without the other. According to Cousins (2005), any strategic approach to supply chain management should combine one of these approaches with a greater emphasis on either RBV or TCE.

The RBV considers the firm as a bundle of resources and capabilities which, when combined, become sources of economic rents and sustainable competitive advantage (Barney 1991; Grant 1991). Companies can differentiate themselves in a variety of ways by combining and recombining these resources to take advantage of market conditions. In other words, the RBV is currently the dominant theoretical perspective in strategic management literature, and focuses on costly to copy attributes of a firm which are seen as the fundamental drivers of performance (Conner 1991; Rumelt 1997, 2005; Schulze). Generally RBV defines resources broadly to encompass assets, knowledge, capabilities and organisational processes (Bharadwaj 2000).

Barney (1991) classified resources into physical (e.g. physical technology, plant and equipment), human (e.g. experience and knowledge of individuals associated with a firm such as sales personnel) and organisational capital (e.g. history, relationships and organisational culture). Grant (1991) differentiated between resource and capabilities. He classified resources into tangible, intangible and personnel-based. Tangible resources encompass the financial capital and the physical assets of the firm such as plant, equipment and stocks of raw materials. Intangible resources include assets, for example, reputation, brand image and product quality, while personnel-based resources encompass technical know-how and other knowledge assets including dimensions such as organisational culture, employee training and loyalty. Although resources are considered as the essential units of analyses, companies create competitive advantage by assembling resources that work together to create organisational capabilities (Bharadwaj 2000).

Organisational capabilities are defined as an organisation's ability to assemble, integrate and deploy valued resources, usually in combination or co-presence (Amit & Schoemaker 1993; Russo & Fouts 1997; Schendel 1994). Capabilities consider the notion of organisational competencies (Prahalad & Hamel 1990) and are based on processes and business routines. Grant (1998) explains a hierarchy of organisational capabilities, where specialised capabilities are integrated into broader functional capabilities such as marketing, manufacturing and IT capabilities. Functional capabilities in sequence integrate to form cross-functional capabilities such as new product development capability and customer support capability. For instance, a firm's customer support capability may have roots in the cross-functional integration of its marketing, operations and IT capabilities (Bharadwaj 2000).

Day and Wensley (1988) recommended a framework to explain the nature of competitive advantage. They divided their model into three distinct outcomes: sources, positions and performance (SPP). Acquiring superior skills and resources (i.e. sources of advantage) leads to positions of advantage which take into consideration customer and competitor perspectives. Competitor centred judgments evaluate the value chains of companies versus those of target competitors. Customer focused perspectives are measured by comparing the customers' attribute ratings of a firm with those of its competitors (Day & Nedungadi 1994). In brief, the perspectives of both customers and competitors are basically positional

advantage (Day & Wensley 1988), hence, performance is affected (customer satisfaction, loyalty, market share and profitability). The identification of main success factors and the relative rate of investment in skills and resources form a feedback loop that connects performance outcomes to sources of advantage (Day & Wensley 1988).

Barney (1986, 1991) believes that RBV is a potential framework which can be used in conceptual analysis of IT's effects on performance of the firm which links the performance of organisations to resources and skills that are firm-specific, rare and difficult to imitate or substitute. Adopting a resource-based perspective, some researchers have suggested that as investments in IT are easily imitated by competitors, investments per se do not provide any sustained advantages. Rather, it is how companies leverage their investments to create unique IT resources and skills that determine a company's general effectiveness (Clemons 1986, 1991; Clemons & Row 1991; Mata, Fuerst & Barney 1995). Extending the traditional concept of organisational capabilities to a firm's IT function, a firm's IT capability is referred to as ability to mobilise and deploy IT-based resources in combination or co-present with other resources and capabilities. Baharadwaj (2000), by using Grant's classification scheme for resources, classified the main IT-based resources in the following order: the tangible resource comprising the physical IT infrastructure components (IT infrastructure); the human IT resources comprising the technical and managerial IT skills (Human IT resources); and the intangible IT-enabled resources such as knowledge assets, customer orientation and synergy (IT-enabled intangible resources).

Wade and Hulland (2004) believe that information systems resources rarely contribute directly to the attainment of a sustained competitive advantage. Instead, they form part of a complex chain of assets and capabilities that jointly may lead to sustained performance. Information technologies apply their influence on the company through complementary relationships with other company assets and capabilities. IT related supply chain communication resources by themselves are not adequate for companies to attain sustained competitive advantage. They also require to have human resources with technical skills to make appropriate use of the IT resources.

Wade and Hulland (2004) suggested information system (IS) resources to manage external relationships, market responsiveness and manage internal relationships. IS used in managing external relationships help to reinforce community networks (Jarvenpaa & Leidner 1997), to

keep buyers informed (Feeny & Willcocks 1998), to make possible the coordination of buyers and suppliers and to enhance customer service (Azevedo & Ferreira 2007). IS used in market responsiveness contribute to faster delivery (Ross, Beath & Goodhue 1998) to enhance market responsiveness, to raise the capacity, to frequently update information, and to increase ability to act quickly (Lopes & Galletta 1997). Managing internal relationships also refers to the contribution of IS in integration of IT and business processes, the ones that build relationships, and the ones with the capacity to understand the effect of IT related systems on other business areas (Benjamin & Levinson 1993).

2.12 Research model

Different theoretical approaches have been used in IT-mediated supply chain relationships and value creation research. For example, transaction cost economic theory (TCE) has mainly been applied in information system literature and recently, scholars have encompassed the RBV theory to investigate IT and business value in the supply chain context (Kim, Cavusgil & Calantone 2006; Rai, Patnayakuni & Seth 2006; Sanders 2008; Wu et al. 2006; Yao, Palmer & Dresner 2007).

Several studies have used TCE to demonstrate how advancement of IT changes inter-organisational relationships and governance structures. For instance, Malone, Yates and Benjamin (1987) investigate IT in relation to coordination costs in terms of searching and communicating with transacting parties. Gurbaxani and Whang (1991) and Clemons, Reddi and Row (1993) recommend that use of IT reduces transactions through improved monitoring and decreased specificity in coordination. Yao, Palmer and Dresner (2007) have argued that electronically-enabled supply chains have the potential to improve organisational and supply chain-wide performance by enhancing transaction efficacies and coordination effectiveness. Subramani (2004) proposes that IT investment increases firms' competitive advantage, whilst overall there is a limited number of studies that empirically investigate IT-business value. As Rindfleisch and Heide (1997) point out, "the limited research on TCE's performance implication makes it difficult to assess fully its theoretical value and empirical validity".

One the other hand, most RBV-based studies attempt to identify and categorise different IT related resources and examine their impact on business performance. For instance, Bharadwaj

(2000) describes IT capabilities as "the ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities". He categorises three types of capabilities: IT infrastructure, human IT resources and IT-enabled intangible resources.

Although several studies appear to link different attributes of competitive advantage with the application of RBV to business-value some ambiguities and confusion exist. Firstly, the uncertainty in conceptualisation of IT based resources leads scholars to differ in their views and application of various terms for IT resources or capabilities. Secondly, business processes and capabilities which interact with IT capabilities in the process of value creation are not addressed uniformly. Finally, there are ambiguities in how various IT resources interact with other capabilities and business processes to create competitive advantage.

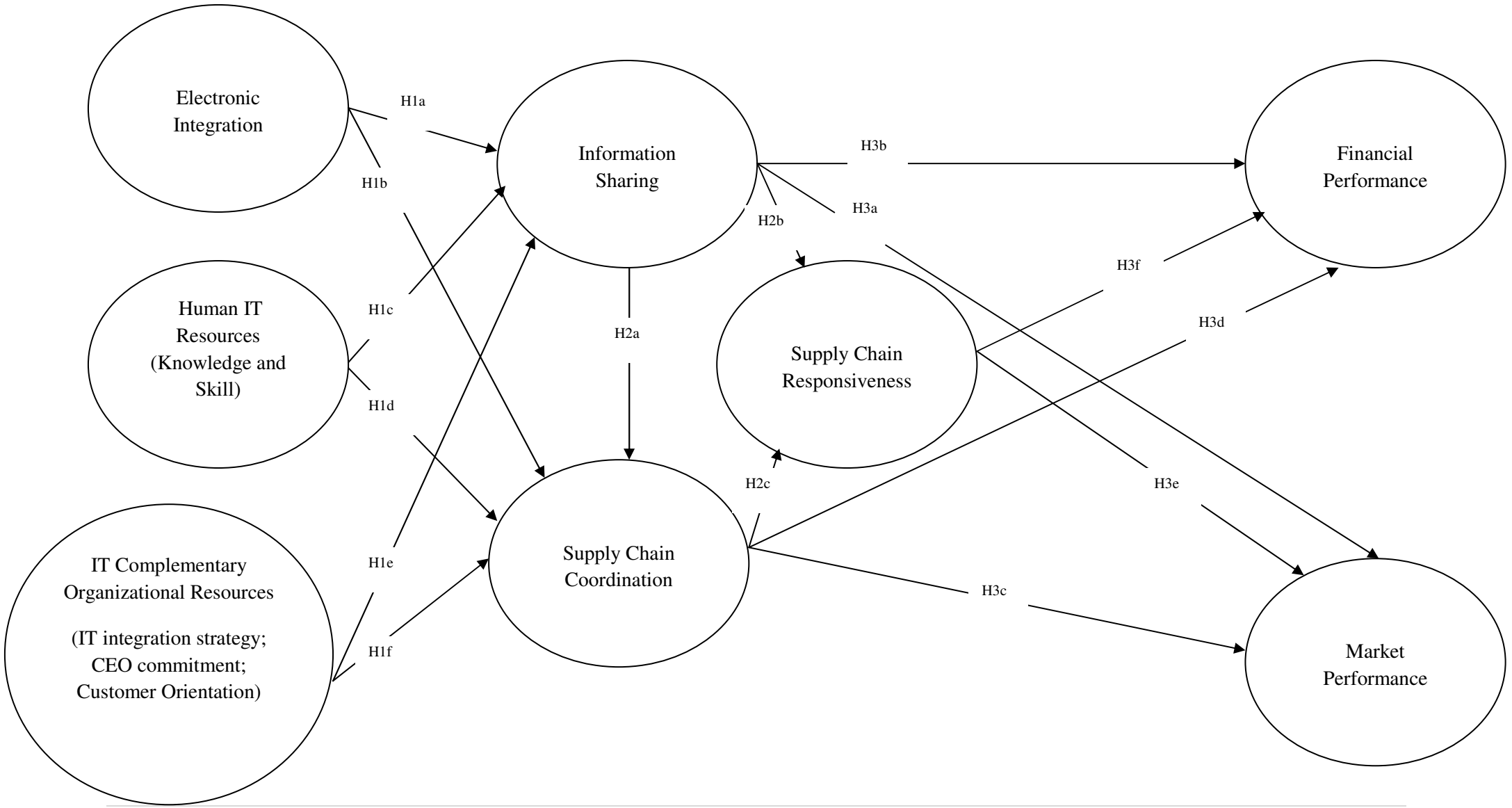
Hence, this research study integrates two important streams of theories and creates a conceptual framework. The framework illustrates whether and how IT capabilities affect firm performance in supply chain relationships (channel capabilities: information sharing, SC coordination and SC responsiveness). The conceptual framework is developed from the perspective of the buyers which explores electronic channel interactions with their main suppliers. Additionally, this research mainly focuses on the electronic integration (EI) in the business to business (B2B) relationship. It has incorporated electronic integration from Kim and Umanath (1999, 2005) and focuses on electronic information transfer (EIT) which serves as the infrastructure for inter-organisational business and process integration.

As depicted in figure 2.8, the proposed conceptual framework is rooted in the emergent stream of RBV associated with IT-business value research and complemented by TCE. According to the RBV, it is argued that companies with specific IT capabilities which are rare, valuable and not easily substitutable can increase inter-organisational capabilities and processes. Furthermore, drawing from TCE, these capabilities (particularly electronic integration) may overcome information asymmetries by making information more visible to market participants, leading to a firm's supply chain relationships (information sharing and SC coordination) being less subject to opportunistic behaviour (Patnayakuni, Rai & Seth 2006; Williamson 1975).

This research focuses on IT capabilities which can effectively and efficiently reinforce inter-organisational processes and restructure exchange relationships (Bharadwaj 2000; Melville, Kraemer & Gurbaxani 2004), electronic integration, human IT resources and complementary organisational resources. These constructs are similar in nature to Bharadwaj (2000)'s classification of IT capabilities which include IT infrastructure, human IT resources and IT-enabled intangibles.

With respect to the dimensions of business processes and structures which mediate the effect of IT capabilities on business performance, this study focuses on channel relationships which encompass information sharing, SC coordination and SC responsiveness. These have been discussed in the literature as significant process and structure mediators of IT's impact on firm performance (Kim, Cavusgil & Calantone 2006; Wu et al. 2006). According to the RBV perspective, information sharing, SC coordination and SC responsiveness capabilities are inter-organisational channel capabilities. Market and financial performance has been widely treated as firm performance metrics in prior studies (Kim, Cavusgil & Calantone 2006; Rosenzweig, Roth & Dean Jr 2003; Tracey, Lim & Vonderembse 2005; Wu et al. 2006). Therefore, both the firm's market and financial performance are adopted as the ultimate outcome variables in this study.

Figure 2.8: Research model and hypotheses



IT Capabilities

Channel Capabilities

Firm Performance

2.13 Research hypotheses

This section articulates the research hypotheses which are based on the research conceptual model and arguments from the literature review in previous sections as well as predictions made by RBV and TCE theories.

2.13.1 IT capability dimensions

IT capabilities as independent variables (exogenous constructs) are categorised as electronic integration, human IT resources and IT complementary organisational resources (IT integration strategy, CEO commitment, and customer orientation).

2.13.1.1 Electronic integration (EI)

Electronic integration (EI) is considered as an important IT resource in the B2B context. Wang et al. (2006) suggest that electronic integration is related to the degree to which supply chain relevant activities among channel members are carried out by inter-organisational information system. Electronic integration can encompass a range of inter-firm channel activities from loose transaction activities to tightly coupled ERP-to-ERP connections to facilitate activities such as collaborative demand planning and fulfilment (Chatterjee, Segars & Watson 2006; Mukhopadhyay & Kekre 2002) and therefore can show varying results on business processes and structures in supply chain exchange relationships.

According to Venkatraman and Zaheer (1994), EI can be defined as "the integration of business processes of two or more independent organizations through the exploitation of the capabilities of computers and communication technologies". Most of the time it involves interaction with the resources controlled by the firm's partners and needs considerable mutual adoption. Hence, any meaningful measurement instrument should capture the degree of electronic integration in different dimensions of the business processes among trading partners (Kim & Umanath 2005; Venkatraman & Zaheer 1994; Wang, Tai & Wei 2006). In an explicitly cooperative relationship, decisions are coordinated between economic activities through processes and information that are specific to the exchange. Therefore, electronic information transfer is considered as an essential component of EI in the literature (Kim & Umanath 1999, 2005).

Information asymmetry among SC happens when either partner in the relationship is privy to information specific to the supply chain relationships that the other is not. Hence, the asymmetries raise transaction risk while integrating decisions and operation in the trading partnership (Rindfleisch & Heide 1997; Williamson 1991). Information asymmetry can cause opportunistic behaviour such as shirking by trading partners. The complexity in measuring the particular contribution of inputs in generating outputs leads to an opportunity for performance shirking by the supplier. If the buyer is unable to monitor the status of the supplier's production process (production capacities, inventory levels, shipping/delivery schedule, quality of products being produced, etc.), the supplier can decrease its effort level. Additionally opportunism can occur in absence of an appropriate number of suppliers, as this raises the dependency of a buyer on a specific supplier. Therefore, transaction risk is the result of difficulties in performance monitoring (Kim & Umanath 1999). Information asymmetry can also be decreased once partners freely share relevant information, for example, electronic exchange of production/sales data, sharing promotion plans and vendor-managed inventory (VMI) (Grover & Malhotra 2003; Kim & Umanath 2005).

Transaction cost economics theory provides the fundamental proposition that electronic integration will overcome information asymmetries by making information more visible to market participants, leading to relationships less subject to opportunistic behaviour (Williamson 1975). The basic concept for electronic transactions proposes that information technologies should allow closer integration of adjacent steps in the supply chain (Malone, Yates & Benjamin 1987). The electronic integration effect provides closer combination of the processes that create and use information. Real time and accurate demand information, together with visualisation of inventory throughout the distribution process, facilitates reduced process and cycle time variance, data errors, and safety stock and attaining better channel coordination (Guo, Fang & Whinston 2006). Many studies recommend that information sharing activities among companies in a supply chain can mitigate the information distortion, known as the bullwhip effect (Chen et al. 2000; Lee, Padmanabhan & Whang 1997b; Yao, Palmer & Dresner 2007). Bakos' (1997; 1991) research about electronic hierarchies and electronic markets determined that electronic markets decrease a buyer's search costs, promote price competition and weaken the market power of sellers. Essentially, electronic hierarchies decrease coordination costs by reducing inventory and monitoring costs. Williams, Esper and Ozment (2002) determined that electronic linkages improve

information sharing among supply chain partners. From the discussion pertaining to EI, it can be postulated that:

H1a: Electronic integration is positively related to information sharing.

One of the main dimensions of electronic information transfer is coordination of decision and operation integration. Costs of coordination are generally explained in terms of coordinating decisions and operations between economic activities among partnering firms. By decreasing the costs of accumulating, communicating and processing information, electronic information transfer can facilitate coordination of decisions and operations (Bakos 1997). In the literature, order products, receive/store products, quality assurance, vendor invoices and payments are considered as main decision and operational activities that happen during trading partners' exchange of goods (Kim & Umanath 2005).

Management of transaction risk is considered as one of the key dimensions of electronic information transfer. Transaction risk includes opportunistic behaviour by a trading partner, which leads to uncertainty surrounding the level and division of the benefits from the improved integration of operations and decisions. Risks generated by transaction specific capital have been historically the focus of TCE theory (Bensaou & Venkatraman 1995; Williamson 1991). Nevertheless, efforts for building stronger integration of decisions and operational activities whilst decreasing costs of coordination aggravate transaction risk. Greater integration of decisions and operations also leads to information asymmetries and loss of resource control which have been recognised as possible sources of transaction risk (Kim & Umanath 2005).

From the RBV perspective, electronic integration is an outside-in resource (Day 1994; Tracey, Lim & Vonderembse 2005) which can create superior firm performance compared to other inside-out IT resources such as advanced infrastructure (Hulland & Wade 2004). Some studies have provided empirical evidence that electronic integration enhances channel capabilities such as coordination and information sharing (Kim, Cavusgil & Calantone 2006; Wu et al. 2006). Hence, this research argues that electronic integration can be treated as a key IT resource which bridges both TCE and RBV perspectives. Overall, this study identifies electronic integration as one the crucial IT capabilities in supply chain B2B context. Firms

are likely to achieve effective and desired levels of channel coordination through superior levels of electronic integration with their partners such as distributors and suppliers. Hence the following hypothesis is elicited:

H1b: Electronic integration is positively related to SC coordination.

2.13.1.2 Human IT resources

Technology is not able to operate in a vacuum. Adequate and competent technical skills and knowledge are necessary for managing and leveraging advanced IT. In previous studies, human IT resources including technical skills and managerial skills have been considered as essential IT capabilities (Bharadwaj 2000; Fink & Neumann 2007; Melville, Kraemer & Gurbaxani 2004). In the initial studies of IT employees in the late 1960s and early 1970s, a main topic of discussion was the significance of technical skills versus managerial and business skills. Several scholars have established that technical skills are dominant for IT programmers and systems analysts, with managerial and business skills being secondary (Strout 1971). This is reasonable because at that time the dominant computing environment was the mainframe computer. Generally, increased (more than two years) software application development cycle times, a narrow but highly skilled technological base and a low strategic focus on IT applications were the characteristics of the mainframe computer period (Clark, Cavanaugh, Brown & Sambamurthy 1997). Throughout this time, IT enabled companies were basically reactive, cost-control enablers and not initiators of strategic efforts.

During the early 1980s, the perception of the skills required by IT employees appeared to change, as indicated in some research, due to IT being viewed as being strategically important (Porter 1985; Sethi & King 1994). With the introduction of personal computers (PCs) and local area networks (LANs), the computer landscape changed fundamentally. These changes obligated the IT enabled companies to evolve. IT employees were expected to align with and support the business strategy of the company (Cross, Earl & Sampler 1997). The computing environment in IT enabled companies moved to a more business responsive environment with shorter software development cycle times, new product innovation and finally the need to satisfy their clients.

Hand-in-hand, with these changes the skill requirements of IT professionals also changed. Some scholars determined that even though technical skills were important, a lack of generalised managerial skills was an obstacle to the development of programmers and systems analysts to managerial positions (Cheney & Lyons 1980; Harrison & Springer 1984; Jenkins 1986). Some proposed that strong business and communications skills were more important than technical skills for entry-level IT positions (Green 1989). Nevertheless, some studies put technical skills at the top of the list (Todd, McKeen & Gallupe 1995; Watson, Young, Miranda, Robichaux & Seerley 1990).

During the 1990s, studies found that IT personnel required a mixture of managerial, business, interpersonal and technical skills to successfully service their organisations (Couger, Davis, Dologite, Feinstein, Gorgone, Jenkins, Kasper, Little, Longenecker Jr & Valacich 1995; Harkness, Kettinger & Segars 1996; Rockart, Earl & Ross 1996; Ross, Beath & Goodhue 1998; Trauth, Farwell & Lee 1993). Rockart, Earl and Ross (1996) suggest that fundamental business changes have forced IT enabled company to value managerial, business and interpersonal skills together with technical skills, among other imperatives.

Byrd and Turner (2001) determined that IT professionals with higher technical and managerial skills led to better IT infrastructure flexibility, a feature of strategic importance to IT and business managers (Byrd & Turner 2000). They also determined that these skills enhanced the competitive advantage in main business management areas (Byrd & Davidson 2003). Duncan (1995), by interviewing CIOs and high-level IT executives from 21 Fortune 500 organisations, identified that many respondents recognised the quality IT employees skills as being a key enabler of main IT services. Harkness, Kettinger and Segars (1996) reported that Bose Corporation had to raise the depth and scope of the skills of its IT employees in order to develop an integrated infrastructure for better supply chain relationships. Cross, Earl and Sampler (1997) also in their case study at British Petroleum determined that its IT department had to be improved considerably to develop and support more integrated and flexible applications.

Mata, Fuerst and Barney (1995) mentioned that the skills of the IT professionals were essential in order to maintain a sustained competitive advantage from an organisation's IT resources. Clark et al. (1997) revealed in their in-depth case analysis of Bell Atlantic that effective IT capabilities meant a highly skilled, empowered and energised IT workforce, with

an entrepreneurial orientation towards providing technological knowledge into business applications.

From a RBV standpoint, several studies have depicted that human IT resources are rare and difficult to acquire and therefore could be a source of a firm's competitive advantage. IT skills provide an essential element of adaptability, enabling firms to leverage whatever degree of flexibility is given by their physical IT infrastructure. These hardcore IT skills are used for information integration which involves sharing of pertinent knowledge and information among members of a supply chain (Fink & Neumann 2007; Byrd & Davidson 2003). It may involve sharing of design and manufacturing data among suppliers, focal manufacturer, and customers. It may also include sharing forecast and delivery scheduling data between the logistics functions of customers, the focal company, the suppliers, the carriers, and the other members of the supply chain (Bagchi & Skjoett-Larsen 2003). Hence, human IT resources are considered as one of the main IT capabilities which can help companies successfully manage their supply chain activities and improve their information sharing. From the foregoing discussion it can be postulated that:

H1c: Human IT resources are positively related to information sharing.

IT integration permits management to examine the operations of the organization holistically and not in a fragmented, functionally isolated manner. On the one hand, highly specialised IT personnel are needed to solve today's complex IT problems and on the other hand, IT personal need general knowledge to cope with changing demands from the business perspective. Therefore, the participants in a supply chain can be linked by information technology for such logistics activities as inventory management, order fulfilment, production planning, and delivery planning and coordination (Saraf, Langdon & Gosain 2007; Byrd & Davidson 2003). For instance, in an empirical research conducted by Kim et al. (2006) in the supply chain context, it is shown that the accumulation of internal IT skills and knowledge in the company enhances inter-firm coordination directly. Business needs drive managers to become more competitive and they are under increased pressures to integrate the supply chain. Integration often requires coordination of disparate functions among supply chain partners. Therefore, human IT resources are considered as one of the important IT

capabilities in the company which directly enhance supply chain coordination. Hence the following hypothesis has been elicited:

H1d: Human IT resources are positively related to SC coordination.

2.13.1.3 IT complementary organisational resources

While it is possible to use IT for improved organisational performance with minor organisational changes (McAfee 2002), successful IT use is regularly accompanied by significant organisational change (Brynjolfsson & Hitt 2000, 2003; Cooper et al. 2000). In other words, in the context of a firm's IT capability, a question that is becoming gradually more important for many senior managers is "how do investments in technology create superior intangible resources for the firm?" (Bharadwaj 2000). Once synergies between IT and other resources of the firm exist, it can be termed as the complementary organisational resources. RBV studies provide guidance concerning the categorisation of complementary organisational resources. Barney (1991) classified complementary organisational resources as non-IT physical capital resources, non-IT human capital resources, and organisational capital resources.

Some IT complementary organisational resources have been investigated in previous studies. For instance, Bharadwaj (2000) suggested customer orientation, knowledge assets and synergy as three IT-enabled intangibles. Powell and Dent-Micallef (1997) in their empirical study identify that companies can gain competitive advantage by using IT to leverage complementary human and business resources such as strategic planning/IT integration in supplier relationships. Jean, Sinkovics & Kim (2008) also suggest some guidelines for advanced electronic partnering capabilities which include IT and business strategy congruency, organisational design campaign, relational campaign and technology architecture campaign.

This study looks at some IT implementation arrangements as complementary organisational resources in the context of SC relationships, which are required to support electronic integration in channel capabilities settings. Firms face many challenges and difficulties in building electronic links in order to coordinate and share information with trading partners

(Auramo, Kauremaa & Tanskanen 2005; Byrd & Davidson 2003; Ngai & Gunasekaran 2004). Hence, IT implementation arrangements such as IT integration strategy, CEO commitment (top management support) and customer orientation are required to support IT adoption in supply chain activities (Byrd & Davidson 2003; Gunasekaran & Ngai 2004; Lin, Yu-An & Shu-Woan 2007; Wu, Mahajan & Balasubramanian 2003). This research study proposes that IT implementation arrangements are important complementary organisational resources which can support electronic integration to gain benefits for firms in B2B supply chains. It contends that with efficient IT implementation arrangements serving as complementary IT resources, greater IT capability will increase business processes and structure dimensions in supply chain relationships.

2.13.1.3.1 IT integration strategy

IT scholars, consultants and executives have universally indicated that companies should integrate IT with overall strategic planning efforts (Bakos & Treacy 1986; Breath & Ives 1986; Clemons & Row 1991; Holland, Lockett & Blackman 1992; Porter & Millar 1985; Rackoff, Wiseman & Ullrich 1985). IT-strategy integration is considered as a potential advantage-producing complementarity (Powell & Dent-Micallef 1997). Clemons (1986) suggest that "the importance of selecting strategic opportunities, applications that are consistent with and support the firm's strategic objectives, requires real links between management information system and strategic planning. It also requires the ability to seek out, to find, and to recognize these strategic opportunities". Additionally, Rockart and Short (1989) mention that not only does planning improve IT effectiveness, but IT may provide the systems and information that can make planning more effective and create a symbiotic IT-planning relationship.

There are several empirical studies which support a positive relationship between IT plans and the successful use of IT. Sabherwal (1995) carried out a study of 36 organisations, where 16 of the 18 successful users of IT had formal IT plans. Raghunathan and Raghunathan (1994) empirically examined the hypothesis that IT planning predicted IT success and found support for their hypothesis. Premkumar and King (1994) empirically tested the relation between IT planning and its contribution to the organisation's performance and proved a positive relationship. Doll (1985) found that companies with successful information systems were three times more likely to have and use formal plans for systems development.

Kim and Narasimhan (2002) stated that communication technology must have the potential to be a strategic weapon in at least one of the following: gaining competitive advantage, improving productivity and performance, enabling new ways of managing and organising, and developing new business. These views propose that the utilisation of IT in strategic and managerial activities is more important than their use in the operational context. Hence, only implementing IT, for example in invoicing automation, is not likely to lead to greater business efficiencies. Despite the importance of IT integration in strategic business strategy, in the SCM context the vast majority of companies view IT primarily from an operational perspective. This could possibly be due to the relative novelty of IT, which means larger-scale and strategic solutions will only arrive, after companies have installed a basic infrastructure (Auramo, Kauremaa & Tanskanen 2005).

The impact of IT on the supply chain is a measure of the influence of IT applications across many activities, some integrating functions of the company with each other and some with external entities such as customers and suppliers (Byrd & Davidson 2003). Use of IT plans can enhance the communication among IT executives and business executives and increase the possibility for effective application of IT resources in the firm, including in the supply chain (Reich & Benbasat 2000). Enterprise-wide plans should possibly find support with line managers in developing and implementing IT applications in the B2B supply chain activities (Gunasekaran & Ngai 2004; Lind & Zmud 1991; Ngai & Gunasekaran 2004).

Competition between one supply chain and another requires seamless communication within the supply chain partners so that information is shared timelessly and accurately. Anderson, Britt & Favre (1997) stated that despite making huge investments in information technology, few companies acquire the full complement of capabilities. Today's enterprise-wide systems remain enterprise-bound and are unable to share across the supply chain the information that channel partners must have to achieve mutual success. Ironically, the information that most firms require urgently to enhance supply chain management resides outside of their own systems, and few firms are adequately connected to obtain the necessary information.

IT integration, both internally (i.e., internal business processes and communications) and externally (i.e. with SC partners), is a determining factor in achieving strategic benefits from IT. Venkatraman's (1994) IT-intended business transformation model shows that IT integration strategy should start with internal applications. This is followed by inter-

organizational, and finally, sector-wide transformation. Sanders (1992) suggested that internal integration of EDI reflects the variety of the value chain functions (order processing, shipments, inventory, etc.) interconnected through EDI within the company. For instance if a customer sends in a purchase order using e-mail, the firm should be able to process it electronically rather than manually. IT integration allows timely and efficient information exchange among partners. For example, manufacturers can provide up-to-the-minute information about their production needs by giving vendors access to the production planning and control system and vendors can arrange deliveries without the need of any paper transactions. Hence it is postulated that:

H1e (a): IT integration strategy is positively related to information sharing.

Technology undoubtedly becomes more and more important in modern supply chain management especially when firms evolve to the stage where they must excel in terms of coordination with their SC partners (Kim, Cavusgil & Calantone 2005). The success of this depends on how well technology is deployed in the supply chain and whether it is scalable and sustainable for long-term growth. It is important to build technology capability to support both internal supply chain operations and external partnerships with suppliers and customers.

IT integration strategy is not only tied to integrating the technology but it is related to linking and integrating B2B applications, such as placing and processing orders, co-ordinating shipping logistics, fund transfer, bidding , brokering and other SC activities (Clemons & Row 1993; Gunasekaran & Ngai 2004). For instance, a major retailer may well be extremely effective in their own operations, but without effective IT implementation that integrates its suppliers with its own internal business processes, competitive advantages will be lost. Hence the following hypothesis is elicited:

H1f (a): IT integration strategy is positively related to SC coordination.

2.13.1.3.2 CEO commitment

CEO commitment (Top management support) has been investigated in many areas of IT implementation and IT business research (Leonard-Barton & Deschamps 1988) and has long been acknowledged as a main factor in success. The importance that the top management executives place on IT implementation and usage reflects this in various ways, including both their involvement and participation.

Top management involvement can be reflected in the level of funding for IT. It may also encompass the facilitation of technology transfer throughout the firm. Several studies have attributed the significant role of top management executives to the implementation, usage and success of IT in firms (Cash, McKenney & McFarlan 1992; Earl 1989; Harris & Katz 1991; Ravichandran & Rai 2000). For example, Power (2004) investigated the importance of top management commitment for technology implementation in the success of IT investment in B2B relationships. Lin, Yu-An and Shu-Woan (2007) reported that most organisations interviewed revealed that their top management executives had provided adequate leadership plus obtained necessary organisational commitment towards the implementation of IT investments in B2B e-commerce. Therefore, top management support enhances IT success by making resources available for implementation and ensuring continuity in investment over time (Kettinger, Grover, Guha & Segars 1994; Powell & Dent-Micallef 1997).

Henderson and Venkatraman (1993) underlined the role of top management commitment in the success of IT implementation by identifying linkages between IT, strategy and organisational infrastructures. They suggest that successful IT needs a senior manager who acts as "business visionary" and "prioritizer" clearly supporting and articulating the requirement for IT, and communicating its functionality in the context of the organisation's strategy, structure and systems. Neo's (1988) study reveals a similar result, that "management vision and support" differentiated successful from unsuccessful IT implementers. Similar findings are reported in Quinn's (1987) concept of "top level risk-taking support", in Maidique and Hayes's (1984) "field general", and in Benjamin, Rockart, Morton & Wyman's (1984) concept of the "senior management entrepreneur" who is willing to view IT as an essential part of business thinking, to test how strategic decisions are affected by ITs, and to test cross-functional IT applications.

CEOs' and senior level managers' attitudes towards change considerably influence implementation decisions (Damanpour 1996; Frambach & Schillewaert 2002). IT initiatives now represent a core component of the strategic planning process in many businesses. Therefore, top management executives have the power to decrease interdepartmental conflict and facilitate rapid IT implementation by building an organisation-wide strategic consensus (Dess & Origer 1987).

In the context of communication processes, IT technologies assist information and knowledge flow within and across the boundaries of the business unit and are able integrate earlier truncated information flows into an efficient processing of information and a streamlined knowledge management system (Sawhney & Zabin 2001). Although knowledge is power, and managers both within and across organisations tend to hoard rather than share information, it hinders the treatment of information as a shared corporate asset (Brancheau & Wetherbe 1987). In this context, senior management has the ability to minimise interdepartmental conflict and resistance to information sharing. In the light of the foregoing discussion, the following hypothesis has been developed:

H1e (b): CEO commitment is positively related to information sharing.

CEO commitment means a great deal more than a chief executive giving his or her blessing to the IT system. The key to commitment is not only to provide the necessary funding for the effort. It is first and foremost recognising that the implementation effort will require the sole use of some the best people in the company so that the IT system can be implemented with full authority and responsibility. CEO commitment also relates to the understanding of how implementation will affect the entire company. Top management should provide leadership for the change, rather than playing a passive role (Gunasekaran & Ngai 2004).

It is argued that Internet based e-commerce implementation can impact all corporate functions and can have significant impact on relationships with exchange partners. Implementing IT technologies in procurement and logistics processes may require restructuring and realignment of external relationships with customers and suppliers, in terms of organisational coordination (Sebastian & Lambert 2003; Vijayasarathy & Robey 1997; Wu, Mahajan & Balasubramanian 2003). For instance, many businesses that sell online have had to restructure their partnerships with distributors to avoid a serious backlash. Hence, with top management support only such changes that affect the existing equilibrium in a major way are most likely to proceed. Hence the following hypothesis has been postulated:

H1f (b): CEO commitment is positively related to SC coordination.

2.13.1.3.3 Customer orientation

The importance of customer orientation is apparent in almost every industry, and its positive impact on organisational performance has been widely acknowledged (Jaworski & Kohli 1993; Narver & Slater 1990; Slater & Narver 1994). Customer orientation has been described as an organisation's ability to adequately understand target buyers with the aim of continuously creating superior value for them (Narver & Slater 1990; Wu, Mahajan & Balasubramanian 2003) and as the implication of a continuous, proactive disposition towards meeting customers' requirements (Farley & Webster Jr 1993; Han, Kim & Srivastava 1998; Min, Mentzer & Ladd 2007). An important part of customer orientation is sensitivity to and foresight about the main forces that shape a market and industry. A customer oriented firm is more ready to anticipate future customer requirements and have a long-term vision. It is likely to have a more proactive approach towards implications of new technologies, including those related to managing supply chain relationships.

In achieving high levels of customer orientation, companies should consider IT as a crucial factor. Indeed, customer orientation strategies such as customer relationship management (CRM) are based on the core IT capabilities of the company (Bharadwaj 2000). For instance, Prudential Company invested in an IT system designed to improve its knowledge of customers across all business units. According to Prudential's CIO, "A customer who has a low business value with one unit might have a very valuable relationship if you look at it across the entire enterprise. So we are building an information warehousing capability that allows us to recognize those relationships" (Bharadwaj 2000; Janah 1998).

One of the main capabilities for greater customer orientation is the ability to track and predict changing customer preferences, particularly in volatile markets. IT enables companies to track shifts in customer choices more quickly. The result is more accurate forecasts of product demand and boosted sales of main components (Cronin 1997). At the process level, a higher customer orientation is likely to influence IT implementation in many ways. For example, a customer oriented firm would aim to regularly exchange information with its customers to better understand their requirements and provide better services (Wu, Mahajan & Balasubramanian 2003). A customer oriented firm would produce and store market information that is required to create, maintain and increase a systems approach to

cooperative relationships with supply chain members (Min, Mentzer & Ladd 2007). One of the main components of supply chain channel relationships is information sharing among supply chain partners (Min, Roath, Daugherty, Genchev, Chen, Arndt & Richey 2005). Information gathered via customers by individual companies can serve as the basis for sharing information among supply chain members. In this context, the following hypothesis has been developed:

H1e (c): Customer orientation is positively related to information sharing.

The front line of firms in any business environments is to interact with their customers, with customers' orders being one of the first inputs for the company. How well they are processed in terms of time, quantity, and satisfaction in communication becomes one of the crucial areas on which firms must focus. A customer oriented firm would seek to coordinate better with suppliers towards developing a supply chain that is responsive in all parts to feedback from the marketplace. While customer orientation places high priority on continuously finding ways to deliver greater customer value, an enhanced customer orientation should, in turn, lead to enhanced boundary spanning activity between firms (Han, Kim & Srivastava 1998). If performed efficiently, a higher customer orientation should lead to more intensive implementation of IT initiatives in communication processes. Similarly, a customer oriented firm is more likely to focus efforts and resources to satisfy customer requirements and to implement a proactive disposition towards innovations which facilitate efficient customer transactions and robust customer relationships (Luo & Seyedian 2003; Wu, Mahajan & Balasubramanian 2003). From this discussion, the following hypothesis is elicited:

H1f (c): Customer orientation is positively related to SC coordination.

2.13.2 Supply chain channel capabilities and their impact on Firm performance

Organisational capability is an outcome of knowledge and resource integration within and across firms (Collis 1994). This study focuses on examining one unique set of organisational capabilities – channel capability – and their mediating role between IT-related resources and firm performance. Channel capability refers to the ability of an organisation to identify, utilise and assimilate resources and other capabilities to obtain efficiency in supply chain channel activities and, ultimately, sustainable competitive advantage (Amit & Schoemaker 1993; Bharadwaj 2000; Collis 1994). This research investigates inter-firm information sharing, supply chain coordination and supply chain responsiveness as channel capabilities (Kim, Cavusgil & Calantone 2006). These dimensions are selected because they represent most of the important activities involved in the supply chain process. Each demonstrates an ability to perform inter-organisational activities which are required in supply chain relationships. Furthermore, they underline the dynamic nature of the channel capabilities that enable a company to learn and respond to environmental changes (Amit & Schoemaker 1993; Teece, Pisano & Shuen 1997; Wu et al. 2006). It is suggested that channel capabilities represent a higher level (if not the highest) in the hierarchy of organisational capabilities (Grant 1996), where they need a broad range of knowledge integration. According to Collis (1994) and Grant (1996), they are harder to achieve and therefore are protected to a larger extent from competitive imitation. Channel capabilities possess the virtues of a valuable source of sustained competitive advantage (Barney 1991).

On the other hand, research pertaining to the direct impact of IT on specific firm performance has resulted in inconsistent results, suggesting perhaps that a "productivity paradox" exists (Lim, Richardson & Roberts 2004; Sanders 2007; Sriram & Stump 2004). Several explanations have been offered for this paradox, such as management's failure to leverage the full potential of IT (Dos Santos & Sussman 2000), ineffective implementation (Stratopoulos & Dehning 2000), time lag between IT investment and its actual impact on business performance (Devaraj & Kohli 2000; Rai, Patnayakuni & Patnayakuni 1996) and poor measurement of performance (Bharadwaj, Bharadwaj & Konsynski 1999). Scholars have also attempted to clarify the apparent paradox by drawing attention to the differences within the traditional research disciplines (e.g. economics, production and strategy) from which the studies are derived (Sircar, Turnbow & Bordoloi 2000; Sriram & Stump 2004). The other

view of business value of IT is that IT improves indirectly business performance by fostering inter-organisational relationships (Hammer & Mangurian 1990). Wena, Yenb and Linc (1998) assert that the benefits may be "qualitative, indirect, and diffuse" and recommend that IT can ultimately impact performance by influencing relational outcomes. For instance, Lin, Huang & Lin (2002) found that implementation of Extranet by the Canadian branch of Fuji Film allowed the company to provide a wider range of information to resellers and dealers and also enabled its salespeople to build online relationships with those intermediaries (Sanders 2007).

The resource-based view of IT proposes that companies can and do distinguish themselves on the basis of their IT resources, IT infrastructure, human IT resources and ability to leverage IT for intangible benefits. These resources serve as firm-specific resources, which in combination create a firm-wide IT capability. Whilst each of the individual IT resources are difficult to acquire and complex to imitate, companies that achieve competitive advantage through IT have also learned to mix effectively their IT resources to create an overall IT capability (Bharadwaj 2000). For instance, an efficient electronic linkage when combined with strong human IT resources becomes an effective organisational capability (Winter & Nelson 1982). As a result, companies that are successful in creating superior IT capability in turn enjoy superior firm performance. In this study, the supply chain channel capabilities (information sharing, SC coordination and SC responsiveness) serve as a mediating role between IT related resources and firm performance (Collis 1994; Wu et al. 2006). This research examines two firm performance variables as dependents variables (endogenous constructs): market performance and financial performance.

2.13.2.1 Information sharing

Information sharing refers to the ability of a firm to share knowledge with channel partners to serve downstream customers effectively and efficiently. Such knowledge encompasses any changes in the business environment, for example, market and customer preferences. Timeliness, accuracy, adequacy, completeness, and credibility of information are among the multiple dimensions of information sharing (Mohr & Sohi 1995). In order to utilise the information effectively, it should be exchanged when it required. It is also important that the

information comes from a credible partner or source and in an adequate format, without missing any elements (Mohr & Sohi 1995).

Effective information sharing has been recognised as one of the most essential abilities in the supply chain process (Shore & Venkatachalam 2003). Information sharing is usually achieved through the enhanced use of information technology or a closer integration among supply chain partners (Bagchi & Skjoett-Larsen 2003). However, it is argued that information sharing by itself does not offer much benefit. Alternatively, it contributes to channel capabilities such as coordination and responsiveness of the partnership (Bowersox, Closs & Stank 1999). According to Truman (2000) and Lewis (2001), channel partners share more information in an attempt to enhance coordination. The purpose of efficient electronic linkage is to collect, interpret, filter, store and share data through effective information sharing within and across partners to improve efficiency in coordination activities (Truman 2000).

Information sharing is important to achieve effective coordination in a supply chain. Sahin and Robinson (2002) classified academic research in this area into three categories: no information sharing and no coordination; partial/full information sharing and no coordination; and full information sharing and complete coordination. The first category (no information sharing and no coordination) consists of research by Forrester and Wright (1961), Lee, Padmanabhan and Whang (1997b), Baganha and Cohen (1998), Chen et al. (2000) and Cox, Watson, Lonsdale & Sanderson (2004). Most of these studies relate to information distortion within the supply chain. Generally they found that, without information sharing and coordination, demand variability would be amplified in the SC and each echelon would have to maintain extra safety stock. These researchers clarify the importance of information sharing and argued that coordination reduces demand variance amplification and decreases cost.

The second category (partial/full information sharing and no coordination) includes research by Swaminathan, Smith and Sadeh (1994), Bourland, Powell and Pyke (1996), Iyer and Bergen (1997), Gilbert and Ballou (1999), Chen et al. (2000), Lee, So and Tang (2000) and Chen, Federgruen and Zheng (2001). These authors mostly focus on capacity utilisation with information sharing as a countermeasure to the bullwhip effect. Broadly, these studies examine the benefits of partial and full information sharing without considering coordinated

decision making. They address a range of issues consisting of information sharing strategies, supply chain structures, replenishment strategies and research methodologies. For instance, Gavirneni, Kapuscinski and Tayur (1999) assess cost saving of 50 percent on average when moving from a non-information sharing to a partial information sharing environment. These studies generally contend that information sharing alone does not eliminate the bullwhip effect and also that coordination especially among retail partners is also required.

Authors belonging to the third category (full information sharing and complete coordination) include Parlar and Weng (1997), Chen (1998), Cachon and Fisher (2000), Chen, Federgruen and Zheng (2001), Fisher, Rajaram and Raman (2001), Frohlich and Westbrook (2001) and Fry, Kapuscinski and Olsen (2001). They discuss the importance of information sharing and coordination for performance improvements. In the light of the foregoing discussion, the following hypothesis is postulated:

H2a: Information sharing is positively related to SC coordination.

In a debate of how technology has an effect on firm capability, Clemons and Row (1993) suggest that "just-in-time inventory techniques with key suppliers or customers are reducing channel inventories and improving system responsiveness". In other words, an efficient electronic integration enhances responsiveness of the partnership for which the system is deployed by helping channel members accommodate market changes or customer demands in a timely manner through efficient information sharing and coordination activities (Clemons & Row 1992; Kim, Cavusgil & Calantone 2006).

As an example of enhancing responsiveness, it is revealed in the study by Catalan & Kotzab (2003), the requirements for precise information about real customer demand, especially for products with shorter life cycles. Thus it is important to create transparency in the logistics information system. With tightly coupled supply chains which utilise real time shared information about consumer demand and component supplies, responsiveness can be improved. In this regard, sharing of design and manufacturing knowledge and competencies amongst companies is a vital tool of competition. Information sharing enhances tracking of

customer expectations whilst also reducing product and process development cycle time (Bhatt 2000). In this regard the following hypothesis has been developed:

H2b: Information sharing is positively related to SC responsiveness.

Information sharing leads to supply chain partners gaining adequate visibility to monitor and control the progress of products as they pass through each process in the supply chain. This activity covers data acquisition, processing, representation, storage, and dissemination of demand conditions, end-to-end inventory status and locations, order status, cost-related data, and performance status. Visibility of key performance metrics and process data enables participating members to make an informed situation analysis which is used to in effective decision making.

Information sharing among trading partners may decrease demand uncertainty, and the cost of inventories in the process of matching supply with demand in the supply chain relationships (Frohlich 2002a). Additionally, Information sharing can also enhance the sales volume by reaching customers directly and promptly whenever a new product is introduced, and by tapping into markets that were inaccessible on account of distribution or other infrastructure constraints (Wu, Mahajan & Balasubramanian 2003). Hence, information sharing by enabling supply chain partners to capture, store, and provide information required for ensuring effective decision making has a direct impact on financial performance such as bolstering revenues and/or decreasing costs, and on market performance including market share and customer service. From the following discussion the following two hypotheses have been developed:

H3a: Information sharing is positively related to market performance.

H3b: Information sharing is positively related to financial performance.

2.13.2.2 Supply chain coordination

Transactions are an essential element of any supply chain relationships, and coordination activities for such transactions are critical for efficient supply chain channel activities (Clemons, Reddi & Row 1993). Supply chain coordination in this research is considered as a channel capability, and conceptualised as the extent to which a company coordinates with channel partners efficiently (Kambil & Short 1994; Malone, Yates & Benjamin 1987; Shin 1999). Coordination with supply chain partners encompasses the coordination of materials, finance, manpower and capital equipment from order taking to order follow-up (Sahin & Robinson 2002). In other words, inter-firm coordination ranges from the collection of product and price-related information such as inventory level, new product launch and pricing, to order follow-up activities including order confirmation and shipment tracking.

There are few studies which have investigated the degree to which supply chain partners coordinate their processes, and its impacts on a firm and its supply chain partners. For instance, Burbidge (1961) clarifies how misaligned re-order levels can cause demand variability and uncertainty in supply chains. Li and Liu (2006) reveal that supply chain members can benefit from coordination of quantity discount policies. Vendor management inventory is the other recent development under which suppliers take responsibility for maintaining stock levels at their customers' sites, hence improving their customers' re-ordering decisions (Holweg 2005). Using the computer industry as an example, Lee (2000) described the alignment of value adding tasks in some supply chains. Collins, Bechler and Pires (1997) explain how similar shifts in the automotive value chain can contribute to enhanced supply chain responsiveness and general performance by leveraging core competencies and realigning complexity.

IT in supply chain communication can help efficient coordination activities to the owning firm by either decreasing coordination costs or improving operational efficiency and the quality of the coordination activities at the same cost (Evans, Nairn & Towill 1993; Lewis 2001; Roberts & Mackay 1998; Sahin & Robinson 2002; Shin 1999; Steinfield, Kraut & Plummer 1995; Wigand & Benjamin 1995). In the context of electronic hierarchy where a close relationship is critical (Malone, Yates & Benjamin 1987), companies should be able to obtain improved efficiency in coordination as their IT for supply chain communication

system is enhanced (Clemons, Reddi & Row 1993). Shin (1999) presents an empirical study which supports the positive effect of IT on supply chain coordination. Likewise, Clemons and Row (1993) claim that "IT reduces the cost of coordination, leading firms to coordinate more". In general the literature suggests that implantation of IT enables supply chain members to reduce coordination costs related to logistics activities (Lewis 2001; Lewis & Talalayevsky 1997).

Supply chain integration can be affected by market turbulence arising from factors such as rapid introduction and customisation of products, difficult design specification and customer shifts (Davenport 1998). In addition, various functions and spatially distributed project units of companies require more coordination. Moreover, as competition increases, efforts to reduce cost through just in time purchasing, scheduling and distribution, lead to more frequent monitoring of specified and delivered quality, schedules and other customer expectations.

The advent of intelligent products, whose requirements are rather difficult for individual companies, create the greatest challenges for supply chain relationships. The need arises to focus on narrow product modules with high competitive advantage whilst coordinating with other companies. The processes of conception, design, manufacturer and delivery are therefore becoming very integrated between key supply chain partners, who work with equal vigour and commitment to add the greatest value to end customer continually (Soliman & Youssef 2001).hence, the following hypothesis has been postulated:

H2c: SC coordination is positively related to SC responsiveness.

Supply chain also directly enhances firm performance by furnishing critical coordination of activities across the supply chain. For example, the purchasing department may support the introduction of a new product by simultaneously working with engineering and a supplier to acquire unique high quality parts needed; communicating manufacturing's needs to inbound traffic to ensure safe, consistent delivery of the parts; consulting with marketing and packaging to ensure the equipment and suppliers are available to meet the packaging specifications of customers concerning the new product.

Lin, Huang & Lin (2002) suggest that by improving coordination among supply chain partners, firms can produce and deliver products and services to customers at lower cost and higher speed. This coordination can also enhance shareholder value due to flexible business processes (Srivastava, Shervani & Fahey 1999). Sanders (2008) in her study identified many benefits of coordination on firm performance. She categorised them as first order benefits including cost reductions, inventory turns, and customer service measures and second order benefits including variables such as market share and profitability. Hence, the following two hypotheses have been developed:

H3c: SC coordination is positively related to market performance.

H3d: SC coordination is positively related to financial performance.

2.13.2.3 Supply chain responsiveness

Supply chain responsiveness in this research is defined as the extent to which a firm reacts cooperatively to changes in the environment and market quickly and effectively (Kim & Cavusgil 2009). It elicits the dynamic nature of a company's channel capabilities, which enable a company to develop and renew specific competencies and to better react to shifts in the environment (Collis 1994; Teece, Pisano & Shuen 1997). In modern markets, a reliable, efficient and collaborative response from the entire supply chain is necessary for success (Rogers, Daugherty & Stank 1993). The use of IT, especially electronic integration between supply chain partners, is expected to be a critical factor (Roberts & Mackay 1998; Thatcher & Oliver 2001). This means that the utilisation of IT in supply chains could lead to improvement of responsiveness to market needs and to bring the right products to the right place, in the right time, in order to gain competitive advantage (Novack, Rinehart & Wells 1992).

A good communication system should help companies respond to customer requests (Rogers, Daugherty & Stank 1993) and outperform in the market through on time delivery, efficient ordering procedures, customer alertness, timely assessment of customer requirements (Stank & Crum 1999), better after sale service, and more broadly market orientation (Bowersox, Closs & Stank 1999; Hernández-Espallardo & Arcas-Lario 2003; Kim, Cavusgil & Calantone

2006). Lewis (2001) suggests that IT allows companies to engage in "large scale tracking of customer preferences" which should be associated with stronger channel capabilities, including responsiveness. For example, offering a preferred type of product to the customers at the right time through superior IT capabilities will help expand market share and increase sales in the supply chain (Clemons & Row 1992; Lewis & Talalayevsky 1997).

According to Yusuf et al. (2004), a responsive supply chain has a strong impact on competitiveness and performance as it enables mobilisation of global resources to track evolving changes in technology and material development including market and customer expectations. Inter-dependent companies can focus and rapidly replicate narrow aspects of the value creation process where competitive advantage is greatest (Quinn 1992). Focusing and cooperation within the virtual companies has the potential to increase capability for lowering cost and enhancing quality, speed, flexibility, and production innovation. Consecutively these will lead to higher revenues, profits, market share, and customer loyalty. In this respect, the following hypotheses have been elicited:

H3e: SC responsiveness is positively related to market performance.

H3f: SC responsiveness is positively related to financial performance.

A summary of all research hypotheses is provided in table 2.9.

Table 2.9: Summary of hypotheses

Hypothesis number	Hypothesis
H1a:	Electronic integration is positively related to information sharing.
H1b:	Electronic integration is positively related to SC coordination.
H1c:	Human IT resources are positively related to information sharing.
H1d:	Human IT resources are positively related to SC coordination.
H1e:	IT complementary organisational resources (IT integration strategy, top management support and customer orientation) are positively related to information sharing. H1e(a): IT integration strategy is positively related to information sharing. H1e(b): CEO commitment is positively related to information sharing. H1e(c): Customer orientation is positively related to information sharing.
H1f:	IT complementary organisational resources (IT integration strategy, top management support and customer orientation) are positively related to SC coordination. H1f(a): IT integration strategy is positively related to SC coordination. H1f(b): CEO commitment is positively related to SC coordination. H1f(c): Customer orientation is positively related to SC coordination.
H2a:	Information sharing is positively related to SC coordination.
H2b:	Information sharing is positively related to SC responsiveness.
H2c:	SC coordination is positively related to SC responsiveness.
H3a:	Information sharing is positively related to market performance.
H3b:	Information sharing is positively related to financial performance.
H3c:	SC coordination is positively related to market performance.
H3d:	SC coordination is positively related to financial performance.
H3e:	SC responsiveness is positively related to market performance.
H3f:	SC responsiveness is positively related to financial performance.

2.14 Investigating the efficacy of the research model

As explained in the earlier sections of this chapter, the research conceptual model was developed following a thorough review of the extant literature. It was decided that besides collecting quantitative data to test the hypotheses associated with the conceptual model, it would be prudent to investigate the efficacy of this model using interviews with SC professionals. Hence, semi-structured interviews were conducted with 8 supply chain professionals from organisations dealing with innovative products which performed different supply chain roles (e.g. manufacturer, wholesaler, distributor and retailer). Details of these supply chain professionals and their organisations are shown in Appendix 2. The main objective of the interviews was to investigate the relationships between the different constructs of the conceptual model and their relevance and applicability to the interviewees' organisations. To achieve this objective an interview protocol was developed which was checked and verified by two independent external reviewers for the purpose of clarity, logic, flow and validity. A copy of the interview protocol and the informed consent form are provided in Appendix 3.

Audio records and notes were taken during the interviews which were later transcribed and analysed using content analysis. Weber (1996) suggests that "content analysis is a research method that uses a set of procedures to make valid inferences from text". There are two categories of content analysis, namely, conceptual and relational (Hsieh & Shannon 2005). Conceptual analysis can be thought of as establishing the existence and frequency of concepts in a text. In conceptual analysis, a concept is chosen for examination, and the analysis involves quantifying and tallying its presence. Relational analysis builds on conceptual analysis by exploring the relationships between the concepts identified (Hsieh & Shannon 2005). For the purpose of this study, conceptual analysis was used. Conceptual analysis begins with establishing a set of categories and counts the number of cases that fall into each category. Then, the information is analysed and interpreted.

Content analysis is related to the qualification of elements in the communication stimuli. An element or subdivision of the content may range from large to small, for example, a content analysis could specify the degree of support or opposition on a controversial issue found in a local newspaper (Kassarjian 1977). It could investigate the amount of space devoted to the issue or the number of articles, a sampling of paragraphs or sentences, or even selected key

words or terms. The units of analysis used to analyse the in-depth interviews was “word” and “theme”.

Generally, the smallest unit used is the word. Berelson noted that content analysis can be done on the basis of a single letter as the unit in crypto-analysis and the breaking of international codes (Kassarjian 1977). The word as a unit is similar to what Lasswell refers to as a symbol and may encompass word compounds, for example, phrases, as well as single words. In this type of study one might investigate the relative occurrence of key symbols or value-laden terms such as social, clean, religious, sparkling, democratic, friendly and so on, until the content has been systematically examined relevant to the hypotheses of the research (Kassarjian 1977).

The next larger unit is the theme which is a single statement about a subject. It is amongst the most useful units of content analysis as values, issues, beliefs and attitudes are typically discussed in this form. Nevertheless, it is the most difficult unit of analysis as well. For instance, the sentence “These clandestine Soviet actions on the imprisoned island of Cuba will not be tolerated by the American people” includes assertions about three nations. The coder should be able to decrease this sentence into its component themes before they may be placed in the proper categories (Holsti 1968).

Details of the analysis of the interviews are placed in Appendix 4.

2.15 Summary

The literature review examines, synthesises and integrates research relating to IT capabilities, supply chain channel capabilities and firm performance. This chapter reviewed and discussed the importance of supply chain management in the current competitive global market and highlighted the three main channel relationships dimensions. It also identified some of the main IT technologies and resources which are used by companies in relation to their supply chain partners.

The conceptual framework presented in this chapter is derived by integrating diverse perspectives of IT and organisational performance, and combining two theoretical approaches namely, TCE and RBV. This framework serves as a basis for answering the research questions. This research argues that the adoption of IT systems and technologies alone is inadequate to support firms in their supply chain relationships. Indeed, electronic integration, complemented by human IT resources and complementary organisational resources, can reinforce and restructure specific business processes and structures which are referred to in this study as channel capabilities and include information sharing, SC coordination and SC responsiveness. This in turn may lead to enhanced financial and market performances. Thus, to address the identified gaps in the literature, hypotheses were developed which articulated the relationships between the various components of the constructs in the research model. Finally, the efficacy of the research model was validated by conducting interviews with SC professionals.

Chapter Three

Research Design

3.1 Introduction

Chapter Two outlined relevant concepts and theoretical foundations of the research and established a research conceptual model. This chapter discusses the research methodology as well as data collection and analysis techniques. A quantitative methodology has been utilised which consists of a large survey research. Firstly, the steps towards designing a survey instrument are explained followed by a description and justification of the sample design, the data collection and finally the analysis. The process of ethics approval for data collection is also addressed.

3.2 Research methodology

Research methods are generally categorized into two types, quantitative and qualitative. Although the social science research tends to draw a sharp distinction between quantitative and qualitative techniques of data collection and analysis, the differences are less clear in practice (Easterby-Smith, Thorpe & Lowe 2002). Quantitative data, which entails counting and measuring, can be gathered by such means as observation, interviews, psychological tests, questionnaire, survey, experiments and archival search. Qualitative data, which concentrates on what people say and do, is collected mainly by interviews and observation, and with these latter techniques (interviews and observation) being used to gather both quantitative and qualitative data, the distinction between the two types of data can become blurred. Denzin and Lincoln (2007) argue against any hierarchy of merit in research techniques, indicating that both qualitative and quantitative researchers have valuable things to say, but they emphasise different things in the telling. Quantitative studies emphasise measurement and causal relationships among variables rather than processes, while qualitative studies emphasise the writing of rich descriptions of situations and processes that quantitative research methods cannot acquire. In logistics and supply chain management,

most studies are primarily populated by quantitative research viewed through a positivist lens (Mangan, Lalwani & Gardner 2004).

The objective of quantitative research is to develop and employ mathematical models, theories and hypotheses pertaining to natural phenomena. Quantitative approach also provides the fundamental connection between empirical observation, and the mathematical expression of quantitative relationships. Quantitative approach is considered appropriate when studying relationships between several variables (Neuman 2005). This research attempts to investigate the relationships between IT capabilities, channel capabilities and firm performance. Hence, quantitative approach is utilised in order to measure and test hypotheses based on empirical examination of dependent and independent variables employing statistical techniques. Survey questionnaires are generally used for large-scale data collection.

3.3 Instrument design

According to Davis (2005), instrument design is very much an art that it is essential if a researcher is not to lose focus about the key objectives of the study. In order to develop an instrument for this research, each construct of the research conceptual model needed to be operationalised by measuring relevant variables. The rigorous development of a reliable and valid research instrument minimises measurement errors. One of the common ways among scholars from different disciplines for achieving a low measurement error is to draw from existing, previously validated measures for the various constructs. The process of instrument design and development for this study is henceforth discussed.

3.4 Identifying the domain of constructs

For developing a precise and valid research instrument it is essential to define the domain of constructs and to generate a sample of items which capture the specified domain. To identify the domain of constructs, one should clarify what is included and what is excluded in the definition of the construct (Churchill 1979). It would not have been possible to encompass all variables that relate to IT related resources and capabilities in the supply chain management context, channel capabilities and firm performance. An extensive review of the literature led to the domain of exogenous (independent) constructs of IT capabilities which included electronic integration, human IT resources and IT complementary organisational resources,

the domain of endogenous (dependent) constructs of channel capabilities which included information sharing, supply chain coordination and supply chain responsiveness) and the domain of endogenous (dependent) constructs of firm performance which included market and financial performances. These constructs are the basis for the research model and have been discussed in the previous chapters.

3.4.1 Generating a sample of items

After the domain of the constructs was properly defined, the constructs were investigated by identifying existing research instruments and developing a pool of items associated with individual constructs. Drawing from already existing and validated research instruments ensures that measurement error is kept to a minimum, and pooling a representative sample of items contributes further towards internal consistency and validity. An extensive literature review was conducted to identify variables which had been used previously to measure the constructs, and useful items were extracted from these variables. The criteria for selection encompassed how well the items had performed in earlier surveys and how relevant they were for this study. The initial items were refined and modified during the pre-testing phase which was aimed at investigating the relevance of each item relative to the construct they operationalised. The following section discusses how the items were selected for the purpose of operationalising the construct (not all items of these scales were used in the final survey instrument, and details of items deleted after pre-testing can be found in Appendix 6).

3.4.1.1 Electronic integration

To measure the construct of electronic integration, the focus was on the ability of firms to integrate business processes of two or more independent organisations through the exploitation of the capabilities of computer and communication technologies. The items generated include the ability of firms to regulate the flow of information between trading partners via electronic linkages. This construct consists of three components: electronic information transfer to coordinate decisions and operation integration, managing transaction risk (information sharing) and managing transaction risk (monitoring and control). The items of the electronic integration construct were derived from the work of Kim and Umanath (1999, 2005) and/or Kim, Umanath and Hun Kim (2006). Table 3.1 displays the factor loading for items in these studies for the electronic integration construct (there are 2 factor

loadings obtained from the 2 studies mentioned above). For all measures, 7 point Likert-type scales were used.

Table 3.1: Items generated for electronic integration

Number	Item	Factor Loading
1	We share common product codes with the supplier either through the same product code tables or computerised code translation table	0.600
2	We transmit purchase order to the suppliers electronically	0.640; 0.733
3	We receive suppliers' invoices electronically	0.739; 0.588
4	We make payments for suppliers' invoices electronically	0.516; 0.650
5	We provide performance feedback such as the quality of product delivered electronically	0.510; 0.610
6	We can trace product failures back to the offending components	N/A[1]
7	We exchange our sale (or production) data with our suppliers electronically	0.679
8	We use the data electronically transferred from the supplier in our business decision	0.789
9	The suppliers determine the order quantity for each item (based on sale data provided by us) and notify us electronically via a purchase order that the shipment is coming	0.555
10	We share our promotion plans on the final products with the supplier electronically	0.593
11	We access supplier's shipping/delivery schedule electronically	0.472
12	We access supplier's inventory level of finished products electronically	0.779; 0.884
13	We access supplier's inventory level of raw materials electronically	0.812; 0.862
14	We can electronically search for alternative suppliers for the product the supplier provides	N/A
15	We can monitor the order status with a supplier electronically	N/A
16	We can monitor the quality of products produced/purchased by the suppliers electronically	0.520; 0.582

[1] N/A: Not Available

3.4.1.2 Human IT resources

The construct of human IT resources measures the degree of technical skills and managerial knowledge in the firm for utilising information technologies. For this study, the items to operationalise human IT resources construct were extracted from the study by Jeffers (2003). For all the measures, 7 point Likert-type scales were used. The sample of items from this construct has been also utilised and validated in previous studies (Jeffers, Muhanna & Nault 2008; Ravichandran & Lertwongsatien 2005; Ray, Barney & Muhanna 2004; Ray, Muhanna & Barney 2005).

Table 3.2: Items generated for human IT resources

Number	Item	Factor Loading
1	Our IT managers understood our key business processes	0.81
2	Our IT managers understand our business strategy	0.80
3	There is common understanding between our IT managers and line managers regarding how IT can be used to improve process performance	0.49
4	The technical skills of our IT staff exceed our main competitors	0.73
5	Compared to our main competitors, we have a relatively small IT group	0.70
6	Our IT and systems development group has the latest technology and tools available	0.78

3.4.1.3 IT complementary organisational resources

As mentioned in the previous chapter, IT complementary organisational resources refer to capabilities which are used to deploy organisational resources which are required to support electronic linkages in channel capabilities settings. The three components of IT complementary organisational resources are IT integration strategy, CEO commitment and customer orientation.

3.4.1.3.1 IT integration strategy

Lauds and Thies (1997) suggest that in order to fully leverage the strategic potential of IT, corporate attempts to re-engineer the firm must take into account the necessary linkages between IT and all the functional areas of the firm. Additional support for this view is provided by Reich and Benbasat (2000) who determined that the use of IT plans can increase the level of communication among IT executives and business executives, enhancing the possibility for effective application of IT resources, in the firm's supply chain. Thus, from the literature four items were identified (see table 3.3) which provide a measure for IT integration strategy to support IT complementary organisational resources in this study. The items for this construct were extracted from Jeffers (2003) (Cronbach alpha 0.87). Power and Dent-Micallef (1997) (Cronbach alpha 0.72) also used similar items for measuring this construct. Jeffers (2003) used 7 point Likert-type scales for measuring all the items. The factor loading for items in these studies are shown in table 3.3.

Table 3.3: Items generated for IT integration strategy

Number	Item	Factor Loading
1	Our company has a formal, long-term strategic plan for IT	0.82
2	Our company has clearly identified IT project priorities	0.77
3	We regularly measure the bottom-line effectiveness of our IT investment	0.77
4	Our IT planning is integrated with our overall business planning	0.74

3.4.1.3.2 CEO commitment

CEO commitment (top management support) has been investigated in many areas of IT implementation and IT business value research and has been recognised as a key to success (Byrd & Davidson 2003; Lederer & Mendelow 1988; Leonard-Barton & Deschamps 1988). Top management support can be discerned by the level of funding for IT or the facilitation of technology transfer throughout the firm. The items for top management support construct were derived from the work of Jeffers (2003) (Cronbach alpha 0.88). Power and Dent-Micallef (1997) (Cronbach alpha 0.92) also used similar items for measuring this construct.

For all the measures, 7 point Likert-type scales were used. Yao, Palmer and Dresner (2007) and Kearns and Lederer (2003) also used some similar items for measuring this construct.

Table 3.4: Items generated for CEO commitment

Number	Item	Factor Loading
1	Our CEO considers IT as the single most critical factor for our firm	0.75
2	Our CEO often gets personally involved in matters related to the use of IT within the firm	0.91
3	Our CEO is in frequent contact with senior IT management	0.87
4	Our CEO views IT as a strategic instrument rather than an expense to be controlled	0.66
5	Our CEO endorses major IT spending that has not been endorsed by traditional justification criteria and procedures	0.59

3.4.1.3.3 Customer orientation

To measure the construct of customer orientation the focus was on the ability of firms to sufficiently understand target buyers in order to continuously create superior value for them. The items used for this construct encompass the adoption of a continuous, proactive disposition towards meeting customers' needs. All six items have been used previously by Wu, Mahajan and Balasubramanian (2003) (Cronbach alpha 0.86). For all measures, 7 point Likert-type scales were used.

Table 3.5: Items generated for customer orientation

Number	Item	Factor Loading
1	Our business objectives are driven by customer satisfaction	0.75
2	We closely monitor and assess our level of commitment in serving customers' need	0.81
3	Our competitive advantage is based on understanding customer' need	0.73
4	Business strategies are driven by the goal of increasing customer value	0.75
5	We frequently measure customer satisfaction	0.70
6	We pay attention to after-sale service	0.58

Supply chain channel capabilities

In this research, supply chain channel capabilities refer to the exploitation of resources and other capabilities to derive efficiency in channel activities. This encompasses information sharing, SC coordination and SC responsiveness. The measurement items are all relational measures that assess the relative position of a firm (participant) in SC information sharing, SC coordination and SC responsiveness, in comparison to its competitors.

3.4.1.4 Information sharing

Information sharing refers to the ability of a firm to share knowledge with its supply chain partners in an effective and efficient manner (Wu et al. 2006). The items developed for this construct are adoptions of the items used from study of Wu et al. (2006) (Cronbach alpha 0.94). Kim et al. (2006) (Cronbach alpha 0.89) also used similar items for measuring this construct. For all measures, 7 point Likert-type scales were used.

Table 3.6: Items generated for information sharing

Number	Item	Factor Loading
1	My company exchanges more information with our partner than our competitors do with their partners	0.851
2	Information flows more freely between my firm and our partner than between our competitors and their partners	0.884
3	My company benefits more from information sharing with our partner than do our competitors from their partners	0.921
4	Our information sharing with trading partner is superior to the information exchanged by our competitors with their partners	0.902

3.4.1.5 Supply chain coordination

The concept of SC coordination in this study measures the ability of a firm to coordinate transaction-related activities with supply chain partners (Clemons & Row 1993; Wu et al. 2006). Table 3.7 displays the factor loadings for the items which are mainly derived from studies of Wu et al. (2006) (Cronbach alpha 0.91) and Kim et al. (2006) (Cronbach alpha 0.886) (there are 2 factor loadings obtained from the 2 studies). For all measures, 7 point Likert-type scales were used.

Table 3.7: Items generated for SC coordination

Number	Item	Factor Loading
1	My company is more efficient in coordination activities with our partner than are our competitors with theirs	0.844; 0.868
2	My company conducts transaction follow-up activities more efficiently with our partner than do our competitors with theirs	0.881; 0.964
3	My company spends less time coordinating transactions with our partner than our competitors with theirs	0.728; 0.702
4	My company has reduced coordinating costs more than our competitors	0.8.16
5	My company can conduct the coordinating activities at less cost than our competitors	0.843

3.4.1.6 Supply chain responsiveness

SC responsiveness construct measures the degree to which the firm, collectively with its supply chain partners, reacts to environmental changes or new market developments. The items to measures SC responsiveness were adopted from studies by Wu et al. (2006) (Cronbach alpha 0.89) and Kim et al. (2006) (Cronbach alpha 0.868) respectively. The factor loadings for items in these studies are shown in table 3.8 (there are 2 factor loadings obtained from the 2 studies mentioned above). For all measures, 7 point Likert-type scales were used.

Table 3.8: Items generated for SC responsiveness

Number	Item	Factor Loading
1	Compared to our competitors, our supply chain responds more quickly and effectively to changing customer and supplier needs	0.875; 0.872
2	Compared to our competitors, our supply chain responds more quickly and effectively to changing competitor strategies	0.874; 0.880
3	Compared to our competitors, our supply chain develops and markets new products more quickly and effectively	0.708; 0.728
4	In most markets, our supply chain is competing effectively	0.765
5	The relationship with our partner has increased our supply chain responsiveness to market changes through collaboration	0.666

Firm performance

In this study, supply chain channel capabilities serve as a mediating role between IT related resources and ultimate outcomes. Firm performance was evaluated using two measures: market performance and financial performance. The items that measure these two constructs need to be comprehensive, detailed enough to be useful, and frequently were frequently used by previous studies. Most research published in SCM use subjective appraisals of performance, with the exception of Lin et al. (2005). Generally measurements of performance are obtained by seeking opinions of responsible top level executives or managers of functional areas. The measurement items for firm performance are all relational measures that assess its relative position in financial and market performances compared to its competitors.

3.4.1.7 Financial performance

One of the ultimate goals of firms is to increase its shareholders' value and decrease costs. Hence, the items to measures financial performance were adopted mainly from three studies: Wu et al. (2006) (Cronbach alpha of 0.920), Kim S.W. (2006) (Cronbach alpha of 0.789) and Seggie, Kim and Cavusgil (2006) (Cronbach alpha of 0.920). The factor loading for items in these studies are shown in the table 3.9 (there are 2 factor loadings obtained from the 2 studies mentioned above). For all measures, 7 point Likert-type scales were used. The sample of items for this construct has been utilised and validated in previous studies (Carr & Pearson 1999; Lummus, Vokurka & Alber 1998; Tan, Kannan & Handfield 1998)

Table 3.9: Items generated for financial performance

Number	Item	Factor Loading
1	My company performs better than our major competitors in overall profitability	0.913, 0.911
2	My company performs better than our major competitors in return on investment (ROI)	0.930, 0.929
3	My company performs better than our major competitors in cash flow from operations	0.830, 0.832
4	My company performs better than our major competitors in total cost reduction	N/A
5	My company performs better than our major competitors in return on assets	N/A
6	My company performs better than our major competitors in financial liquidity	N/A

3.4.1.8 Market performance

Market performance is the other final endogenous construct in this research. Market performance refers to the end result of the price and other market policies pursued by the firm. The items for market performance were adopted from three studies: Wu et al. (2006) (Cronbach alpha of 0.090), Tan, Kannan and Handfield (1999) (Cronbach alpha of 0.809) and Kim et al. (2006) (Cronbach alpha of 0.868). The factor loading for items in these studies are shown in the table 3.10 (there are 2 factor loadings obtained from the 2 studies mentioned above). Some other studies (Kim 2006; Seggie, Kim & Cavusgil 2006) also used similar items for measuring this construct. For all measures, 7 point Likert-type scales were used.

Table 3.10: Items generated for market performance

Number	Item	Factor Loading
1	My company performs much better than competitors in sales growth	0.822, 0.771
2	My company performs much better than competitors in market share	0.811, 0.855
3	My company performs much better than competitors in market development	0.887, 0.904
4	My company performs much better than competitors in product development	0.782, 0.807
5	My company performs better than our major competitors in overall customer service level	0.746

3.5 Scaling and measurement

Likert scales are the most commonly used instruments for measuring opinions, beliefs and attitudes (Anderson, Basilevsky & Hum 1983; DeVellis 1991; Neuman 2005). Named after its developer Rensis Likert, they are easy to construct and administer, with respondents readily understanding how to utilise the scale (Malhotra 2009). It was decided to use seven point Likert scales as they have been commonly used by previous studies for measuring items given in tables 3.1 to 3.10. This is a widely accepted measure and is considered highly reliable when it comes to the "ordering of people with regard to a particular attitude" (Davis 2005). It is a particularly good way of assessing psychological traits that do not seem to lie on a known physical scale (Elmes, Kantowitz & Roediger 1995). However, its disadvantage is that it takes longer to complete than other itemised rating scales (Malhotra 2009). All the

items were then scrutinised by a panel of experts to ensure that they measured what they were supposed to measure.

3.6 Pre-testing

The aim of this stage was to improve the content and face validity of the instrument by consulting experts in the field and asking their opinion regarding the relevance of the items. These experts also determined what meaning potential respondents ascribed to terms used and the context they applied when considering their answers. This helped the researcher to ensure that questions were understood in the way that was intended. The experts consisted of 5 academics and 5 professionals who had adequate knowledge, research and industrial experience in the field. All were either known to the researcher or were acquaintances of the participants (the details of both academics and professionals are provided in Appendix 5). Selection was based on convenience and availability and was considered to be a good mix of academics and practitioners. The experts were encouraged to provide sufficient feedback regarding the items. The experts came from a range of universities and industries, and they had a variety of experiences and research backgrounds. This diversity improved the quality of the feedback regarding the survey instrument.

Generally the experts accepted levels of agreement and confirmation for suitability of the questionnaire; however some recommendations were offered for improvement. After discussion with the research supervisor regarding analysis of the experts' feedback, the following decisions were made, particularly for items which did not obtain support from the panel. Two alternatives were considered for each item. First, it was re-worded if the experts recommended improvements. Second, it was deleted if it had a low average agreement score and was the lowest score in each construct. Appendix 6 gives an overview of the significant instrument changes that resulted from the experts' feedback.

Thus, after defining the domain of each constructs, pooling variables from previously validated research instruments and strengthening their content and face validity using a panel of experts, the survey instrument was deemed to adequately measure the research constructs. The final survey instrument including the cover letter are shown in Appendix 7.

Sample selection for data collection

3.7 Sample design

In an empirical study, it is critical to design a sample which reflects the same results as would be found in the population (De Vaus 2002). Selection of an appropriate and representative sample entails three interrelated aspects: sampling frame, sample selection criteria and sample size (Fowler 2008).

3.7.1 Sampling frame

For examining subjects, one of the possible ways is to collect information from every subject in a group. This can be complex or difficult to understand, especially for large groups. Thus, it is easier and more realistic to use the principle of random sampling. This involves the collection of information from a representative subset of this group and then drawing conclusions about the whole group. Therefore, the subset should reflect the characteristics of the whole group in order to be representative (De Vaus 2002). To ensure the research was comparable to other research studies in this field, a literature review was conducted to determine the sampling frame used by similar studies and the results are displayed in table 3.11.

Table 3.11: Comparison of sampling frames used by previous studies

Author	Method	SC roles	Firm size	Country	Sample size
Kim et al. (2006)	Online survey	All	All	USA	184
Rai, Patnayakuni & Seth (2006)	Mail & online survey	Retailers and manufacturers	All	USA	110
Kim et al. (2005)	Online survey	All	All	USA	184
Yao, Palmer & Dresner (2007)	Mail survey	Manufacturers, distributors, retailers	All	USA	183
Wu et al. (2006)	Online survey	All	All	USA	184
Sanders & Premus (2002)	Mail survey	All	Large	USA	116
Silveira & Cagliano (2006)	Mail & online survey	Manufacturers	All	13 countries	201
Power (2005)	Mail survey	All	All	Australia	553
Sanders (2007)	Mail survey	Manufacturers	Large	USA	245
Lai, Wong & Cheng (2008)	Mail survey	Trading and transportation companies	All	Hong Kong	227
Byrd & Davidson (2003)	Mail survey	All	Large	USA	225
Lo & Power (2010)	Mail survey	Manufacturers	All	Australia	107
Ferrer, Santa, Hyland & Bretherton (2010)	Mail survey	Road freight	All	Australia	132
Devaraj, Krajewski & Wei (2007)	Mail survey	Manufacturers	All	USA	120

The comparison of sampling frames from comparable studies in table 3.11 highlights three main features. Firstly, most studies considered a broad range of SC roles in their sample frames and only a few focused on a specific SC role. Secondly, most investigated firms of all different sizes (small, medium and large). Finally, the majority of studies were conducted in the USA.

As mentioned previously, the supply chain responsiveness construct (as a main source of competitive advantage) in this research is defined as: the extent to which the firm reacts cooperatively to changes in the environment and market quickly and effectively. In addition, Fisher (1997) explains the need to match the appropriate supply chain management strategy to product characteristics (see Chapter 2, Section 2.3). Innovative/fashionable products require a responsiveness supply chain in order to cope with demand uncertainty and short product life cycles. The relatively predictable nature of demand for the functional products facilitates a more efficient supply chain. Therefore this study considers industries related to innovative products, for which responsiveness is important (such as computer and communication, consumer products, and electronic equipment).

The sampling frame of this research is Australian companies. Like majority of previous studies in this field (see table 3.11), this study aims to adopt an approach by focusing and investigating all sizes of organisations. Nevertheless, it should be noted that North America and Australia have different classification regimes on what constitutes small, medium and large organisations. According to the Australian Bureau of Statistics (ABS 2002), business sizes are defined as follows: large companies- 200 employees or more, Medium-sized companies- 20 to less than 200 employees and small companies- less than 20 employees.

3.7.2 Sample size

It is important to give some serious consideration to the minimum required sample size before commencing a survey. In general, the margin of error reduces with an increasing sample size, however, the bigger the sample size, the more cost-intensive the research will be (De Vaus 2001). Thus, it is essential to identify the minimum required returned sample size. For determining this, the desired method of statistical analysis has to be considered. Bartlett, Kotrlik and Higgins (2001) suggest that for factor analysis the minimum required returned

sample size should not fall below 100 and the ratio of independent variables to observations in multiple regression analysis should be greater than five. Based on experience, the expected variability within the sample and the results should also be taken into account.

Since the introduction of SEM (structural equation modelling) in marketing more than a decade ago, it has been used extensively in measurement and hypothesis testing (Bagozzi & Yi 1988). Although there seems to be agreement between researchers that the larger sample size for SEM, the higher the statistical power (Weston & Gore Jr 2006), there does not appear to be clear agreement on how large the required sample size should be to perform SEM analysis. However, there are many indicators that should be taken into account while using SEM. These encompass the desired statistical power, test for close versus exact fit and the complexity of the model (Weston & Gore Jr 2006). MacCallum, Browne and Sugawara (1996) investigated the impact of sample size on the statistical power of covariance structure models (e.g. SEM). Their studies also measured the complexity of models using degrees of freedom assessment and the desired fit assessment (close versus exact fit). This research aims to test hypotheses at a 95% confidence interval. Additionally, the fit statistics was used to identify if the research model represented the collected data in a suitable way, assuming a close fit (RMSEA, CFI, NFI, etc.), rather than an exact fit. Considering all these issues, research on required sample size indicated that a minimum sample of at lease 150 cases would be suitable for this study (Gefen, Straub & Boudreau 2000).

3.7.3 Respondents selection criteria

After the sampling frame and sample size were determined, the next task was to identify the most appropriate types of respondents from the company. This research examines supply chain channel relationships at the business unit level, from the perspective of both buyer and supplier relationships. Ideally, informants need to have some knowledge about their company's supply chain communication technologies, the degree of system and activity integration with SC partners, any enhancement of supply chain channel capabilities their firm has experienced, and the firm's market and financial performances. Hence, the most suitable informant is the supply chain manager. However, some organisations separate procurement functions from logistics activities. Thus, qualified respondents are supply chain managers, logistics managers or procurement/purchasing managers. The results of the literature review

on previous studies in this area (for example, table 3.11) and also the panel of experts suggested that the selection of respondents was similar to those in previous studies. Generally supply chain/logistics or procurement/purchasing managers were perceived as being the most knowledgeable about the issues concerned.

The next task was to identify lists that could be potentially representative of such a sampling frame and to select the list that was most appropriate for this study. The selection criteria for the lists included completeness in the form of contact addresses and required sample size. This survey covered a sample of 2,000 companies that were members of GS1 Australia (majority members of GS1 Australia are from FMCG industries and suitable for this research). This is the organisation that administers, validates and issues standard barcodes, electronic product codes and product numbers to Australian companies. As well as promoting the use of these barcodes, GS1 markets a system for the adoption and implementation of B2B enabling technologies for the management of supply chains (for more information about GS1 services and products see Appendix 1). As such, members of this organisation are involved in using B2B enabling technologies within their operations.

3.8 Data collection

Issues relating to mail surveys including response rates have been extensively discussed. Frohlich (2002b) pointed out that one in three managers now refuses to participate in any surveys. Jobber and O'Reilly's (1998) comparison of industrial and non-industrial populations suggest that industrial respondents respond differently and require specific approaches. The primary data collection method for this study was a survey questionnaire. This was chosen for large-scale data collection over other methods (such as interviewing or direct observation) due to the advantages it offers concerning available time for respondents and the researcher, convenience for respondents, geographical area coverage, energy levels required and costs (Sekaran 2006). It was decided to include a cover letter, a copy of the questionnaire and a postage-paid return envelope which was mailed to the supply chain/logistics managers of GS1 members in Australia. A copy of the questionnaire and the cover letter are provided in Appendix 7.

3.9 Data analysis

This section briefly explains the statistical techniques and software which were used in this thesis. In the following chapter, statistical procedures are discussed. Coorley (1978) and Maruyama (1997) state that the purpose of statistical procedures is to support in establishing plausibility of the theoretical model and to measure the degree to which independent variables are likely to influence the dependent variables. Data analysis in quantitative study has been divided into two parts. The first part entailed data screening and cleaning, descriptive statistic, and testing the reliability of measurement using SPPS software application. The second part involved testing validity of the measurement of models by using convergent and discriminate validity, analysing data (confirmatory factor analysis) using AMOS software program.

SPPS, as a widely accepted program for data analysis (Malhotra 2009; Tabachnick & Fidell 2006; Zikmund 2003), has been used to report the descriptive analysis and reliability tests of the data analysis. In addition, AMOS, one of the main software programs, was used to measure and assess the constructs and the overall structural model (Byrne 2001; Ullman & Bentler 2004). AMOS 17.0 provides researchers with a powerful and easy to use SEM software which helps to create a more realistic model than would have been possible through using standard multi-variate statistics or multiple regression models. By using AMOS 17.0, the analysis was able to estimate, specify, assess and present the model in an intuitive path diagram which showed the hypothesised relationships between variables.

3.10 Ethics

Ethics approval to carry out this research was obtained from Swinburne University of Technology's Human Research Ethics Committee (SUHREC) which is in line with the National Statement on Ethical Conduct in Research Involving Humans (see copy in Appendix 8).

3.11 Summary

The chapter has outlined the research methodology as well as data collection and analysis techniques for this thesis. A quantitative method for the research methodology, which consists of a survey questionnaire study, has been outlined in this chapter. The sampling frame consists of companies who are members of GS1 Australia. The instrument development process has been described so as to minimise measurement errors. Later the sample design was outlined, and the sampling size, frame and selection criteria were explained and justified. Finally, the chosen data collection method was explained. To fulfil the purpose of the quantitative study SEM was used as the main statistical technique for data analysis.

Chapter Four

Analysis and Results

4.1 Introduction

This chapter focuses on the analysis of quantitative data. Its purpose is to summarise and present the results of the information collected in the survey questionnaire and empirically examine and test the hypotheses associated with the proposed model explained in Chapter Three. This chapter comprises five principal sections. The first section deals with screening and cleaning data, testing for non-response bias and describing the normality of the items. Section two describes the profile of the respondents and that of their organisations. The third section examines the psychometric properties of the measures utilised in terms of reliability and validity for each construct. Section four presents the confirmation of hypothesised latent constructs and discusses how each was tested before developing the structural models. Finally section five illustrates how the structural models were tested and also how the best-fit model was achieved.

4.2 Data screening and cleaning

Screening and cleaning of the data was executed in several steps. Firstly, the data was entered from the questionnaires into an Excel file. There the data was sorted according to date and time. Secondly, an identifier was assigned, so that each respondent had a unique identification number. Thirdly, the format of the data and variable names were adjusted, so that they could be imported into SPSS and AMOS statistical software packages.

The first issue related to the accuracy of data which were entered in the Excel spreadsheets. Screening for accuracy involves examination of maximum and minimum statistics. This study found that all values were within the seven point likert-type scales range. Next, the enteries were checked for missing data. A total of four out of 256 cases (1.56 percent) were missing, and these related to different items in the survey instrument. These four cases were not included in the final analysis. Table 4.1 depicts the final survey response rate.

Table 4.1: Survey response rate

Surveys	Frequency	Percent
Distributed	2000	100%
Returned	256	12.8%
Usable	252	12.6%

4.3 Estimating non-response bias

The research design was based on the assumption that it is possible to generalise from the sample to the population. As with most survey data, there is always a degree of non-response, as not all addressed participants return a completed questionnaire. This may cause sample bias and problems of generalisation of research findings to the population. One method for analysing non-response bias is by screening responses according to date of reply. Participants who respond later are assumed to have similar characteristics to non-respondents. Comparing the characteristics of early and late respondents identifies a non-response bias (Collis, Hussey, Hussey & Inglis 2003).

There is no accepted norm concerning the characteristics that is used to compare early with late respondents. However, literature suggests that respondents who are more interested in the survey respond earlier than others, hence leading to non-response bias based on differences in interest (Lewis-Beck, Bryman & Liao 2003). Therefore, variables which might affect willingness and interest to participate in this survey were identified. Since this research investigates the impact of IT capabilities on supply chain channel capabilities and their impact on firm performance, companies with stronger IT capabilities may possibly be more interested in participating in the survey compared to those with weaker IT capabilities. Thus, several variables which could lead to an interest bias within the sample population were identified. Firstly, respondents whose organisations had relatively stronger IT capabilities may have been more likely to respond, in so far as they may be proud of their organisations' capabilities and might want to see if those impacted on other factors such as supply chain channel capabilities and firm performance. Secondly, top level managers such as CEOs from firms with relatively stronger IT support for core competences may have been more willing to participate than others. Finally, respondents from firms which had identified the importance of IT capabilities and technologies might have been more willing to respond, hence the result

might have been biased. Essentially, the variables selected to estimate non-response bias were:

- Average mean of IT capabilities;
- Average mean of supply chain channel capabilities;
- Average mean of firm performance.

The final sample was divided into two sub-samples. The first sub-sample comprised the first 189 (circa 75 percent) responses; the second sub-sample comprised the last 63 responses (circa 25 percent). The statistical test to compare the sub-samples was a two-samples independent t-test at a 5% significance level. The results of the independent sample t-test are shown in table 4.2.

Table 4.2: Independent sample t-test to check non-response bias

Construct	t	p	Mean differences	Std. Error differences
Mean IT capability	0.37	0.68	0.05	0.12
Mean supply chain channel capabilities	1.10	0.26	0.16	0.14
Mean firm performance	1.36	0.18	0.29	0.23

The results revealed no significant differences between the two sub-samples at a 95% confidence interval for the chosen characteristics. Thus, even if there was a non-response bias, it was not significant enough to cause bias to the data or to deter generalisation from the sample to the population.

4.4 Normality

In general, normality of variables can be assessed by either statistical or graphical methods. In order to check the actual deviation from normality for this research study, three methods – univariate skewness, univariate kurtosis and multivariate kurtosis – were employed. Distribution is considered to be within a normal range when indicators of univariate skewness and univariate kurtosis values are less than 2 and 3, respectively (Azzalini 2005; Hair, Anderson, Tatham & Black 2003). As the univariate skewness and univariate kurtosis values

of all items in the survey instrument were all less than 2, it was assumed that the univariate skewness and univariate kurtosis were relatively small for each item. Hence, these items were considered to be normally distributed.

Some of the multivariate kurtosis values were greater than 8, which might have presented a problem with the functioning of structural equation modelling. In such cases of multivariate non-normality in this study, Bollen-Stine's bootstrap was invoked (Kline 2005). Bootstrapping is a statistical re-sampling method (Diaconis & Efron 1983) in which the software draws samples from a probability density function with parameters specified by the researcher. The Bollen-Stine option signifies a modified bootstrap method for chi-square goodness-of-fit statistic, and provides a means of testing whether the null hypothesis of that specified model is correct (Bollen & Stine 1992; Enders 2002). For this research study, AMOS was used to perform a bootstrap on the sample and the result was within the sufficient range as suggested by Hair et al. (2003).

4.5 Profile of respondents and their organisations

This section discusses sample characteristics of the respondents (job title and job function), industry sector, annual sales, employee number, company's role in the supply chain, usage of business to business enabling technologies, usage of GS1 Australia products and services, and finally comparison of the technology application and the three major roles (manufacturing, wholesaler, and distributor) in the supply chain.

Industry sector: Table 4.3 shows the industry sectors for the final sample of this study. However, as mentioned in the methodology chapter, this study follows Fisher model (1997) and considers only industries dealing with innovative products for which SC responsiveness is important. Hence, the remainder of this study focuses only on a sample of respondents whose organisations deal with consumer products, computer and communication and electronic equipment. This reduced the sample produce size to 169 responses. Table 4.4 shows that majority of the respondents (89.9 percent) were from companies dealing with consumer products such as food and dairy products, beverages, cosmetics, apparel, and tobacco products. The sampling frame is essentially membership of the GS1 organization in

Australia, which is representative of the fast-moving consumer goods (FMCG) industries. As revealed in table 4.4, 10 percent of the respondents worked in companies dealing with computer and communication, and electronic equipment.

Table 4.3: Industry sector (total sample)

Industry sector	Frequency	Percent[2]
Automobile	13	5.2
Computer & communication	12	4.8
Consumer products	152	60.3
Chemical	9	3.6
Electronic equipment	5	2.0
Industry machinery	8	3.2
Medical equipment	14	5.6
Other	39	15.5
Total	252	100

Table 4.4: Industry sector (the sample used for this study)

Industry sector	Frequency	Percent
Consumer products	152	89.9
Computer & communication	12	7.1
Electronic equipment	5	2.9
Total	169	100

Job title: 139 of the respondents (82.2 percent) were managers, whilst 10 or 5.9 percent stated that they were directors and 11 (6.5 percent) were titled CEO/president. 9 of the respondents (5.3 percent) were identified as belonging to the "other" category.

[2] Note: The percentages are rounded to the first decimal place.

Table 4.5: Job title

Job title	Frequency	Percent
CEO/ president	11	6.5
Director	10	5.9
Manager	139	82.2
Other	9	5.3
Total	169	100

Job function: The respondents were asked to select a job function that best described their role in the organisation. As shown in table 4.6, majority of the respondents (46.7 percent) chose corporate executive, 17.1 percent chose purchasing/ procurement, 4.1 percent transportation, 11.8 percent chose manufacturing production, 4.7 percent chose distribution, and 3.5 percent chose sales & marketing. The rest (11.8 percent) belonged to the "other" category which included logistics, and operations management.

Table 4.6: Job function

Job function	Frequency	Percent
Corporate executive	79	46.7
Procurement/ purchasing	29	17.1
Transportation	7	4.1
Manufacturing production	20	11.8
Distribution	8	4.7
Sales & marketing	6	3.5
Other	20	11.8
Total	169	100

Role of company in the supply chain: The respondents were asked to select all roles their companies played in the supply chain (a respondent could choose more than one role). As shown in table 4.7, majority of respondents chose manufacturer (56.8 percent), wholesaler (50.9 percent) and distributor (33.1 percent). Others roles selected were raw material supplier (8.3 percent), assembler (3.5 percent), component supplier (2.9 percent), sub-assembler (4.1 percent) and retailer (14.2 percent).

Table 4.7: Company's role in the supply chain

Role of company in SC	Frequency	Percent
Raw material supplier	14	8.3
Assembler	6	3.5
Manufacturer	96	56.8
Component supplier	5	2.9
Sub-assembler	7	4.1
Distributor	56	33.1
Wholesaler	86	50.9
Retailer	24	14.2

Number of employees: As shown in table 4.8, majority of the respondents' organisations (64.5 percent) had fewer than 50 employees and the rest of the respondents' organisations (35.5 percent) had more than 50 employees.

Table 4.8: Number of employees

Employee number	Frequency	Percent
1 to 50	109	64.5
51 to 100	9	5.3
101 to 250	20	11.8
251 to 500	10	5.9
501 to 1,000	5	2.9
1,001 to 5,000	16	9.5
5,001 to 10,000	0	0
Over 10,000	0	0
Total	169	100

Annual sales: Table 4.9 reveals that majority of respondents had annual sales between 5 million to 25 million. It also shows that 88.2 percent of total respondents had annual sales less than 100 million. The rest of respondents (11.8 percent) had annual sales of more than 100 million.

Table 4.9: Annual sales

Annual sales	Frequency	Percent
Under 5 million	34	20.1
5 to 10 million	56	33.1
10 to 25 million	35	20.7
25 to 50 million	15	8.9
50 to 100 million	9	5.3
101 to 499 million	10	5.9
500 to 999 million	4	2.4
1 to 4.99 billion	6	3.5
Over 5 billion	0	0
Total	169	100

4.5.1 Sample characteristic of technology type

Usage of B2B enabling technology: As shown in table 4.10, all respondents reported that they used e-mail and Internet. 79.3 percent had their own web sites for providing information about their products and services (e.g. catalogue of products, prices, online sales, etc.) and 40.2 percent used technology for conducting transactions (e.g. financial transactions). 23.7 percent of companies used Extranet (secure extension of an Intranet that allows external users to access some parts of an organisation's Intranet by using a password) and 23.7 percent used enterprise resource planning (ERP) systems. 43.8 percent of respondents used electronic data interchange (EDI/ XML), while 69.8 percent used bar-coding and standard numbering technology and only 10 percent used radio frequency identification technology (RFID).

Table 4.10: Usage of B2B enabling technology

B2B technology	Frequency	Percent
E-mail & Internet	169	100
Web site for product and services information	134	79.3
Web site for conducting transactions	68	40.2
Extranet	40	23.7
Enterprise resource planning systems	40	23.7
Electronic data interchange	74	43.8
Bar-coding and standard numbering	118	69.8
RFID	17	10.0

GS1's products and services application: Details about GS1 Australia and their products and services were discussed in Chapter Two and in Appendix 1. As shown in table 4.11, 92.3 percent of the respondents reported that they implement GS1 bar-coding number and system (GTIN) in their business. 10.6 percent use GS1 data synchronisation, while 10 percent implement GS1 electronic product code (EPC) standards. 2.9 percent and 10.6 percent of respondents implement GS1data bar and GS1 system (e.g. e-messaging standards) in their business respectively. 12.4 percent implement GS1net, and 11.2 percent use GS1 education and training in their business.

Table 4.11: GS1's products and services application

GS1 Products and services	Frequency	Percent
GS1 bar-coding number and system (GTIN)	156	92.3
GS1 system (e.g. e-messaging standards)	18	10.6
GS1 data synchronisation	18	10.6
GS1 electronic product code (EPC) standards	17	10.0
GS1 data bar	5	2.9
GS1 net	21	12.4
GS1 education and training	19	11.2

4.5.2 Usage of B2B enabling technology by manufacturers, wholesalers and distributors

Table 4.12 shows the usage of B2B enabling technology by three major supply chain roles in this study (manufacturers, wholesalers and distributors). It reveals that manufacturers used majority of B2B technology more, compared to wholesalers and distributors.

Table 4.12: Usage of B2B enabling technology by manufacturers, wholesalers and distributors

B2B Technology	Manufacturer (%)	Wholesaler (%)	Distributor (%)
E-mail & Internet	95.8	95.3	100
Web site for product and services information	84.3	83.7	76.8
Web site for conducting transactions	40.6	33.7	37.5
Extranet	27.1	23.2	26.8
Enterprise resource planning systems	29.1	17.4	19.6
Electronic data interchange	38.5	40.7	46.4
Bar-coding and standard numbering	65.6	73.2	73.2
RFID	12.5	5.8	8.9

4.5.3 Usage of GS1 products and services by manufacturers, wholesalers and distributors

Table 4.13 shows the usage of GS1 products by three major supply chain roles in this study (manufacturers, wholesalers and distributors). It reveals that distributors used majority of GS1 products and services more, compared to manufacturers and wholesalers.

Table 4.13: Usage of GS1 products and services by manufacturers, wholesalers and distributors

GS1 Products and services	Manufacturer (%)	Wholesaler (%)	Distributor (%)
GS1 bar-coding number and system (GTIN)	87.5	96.5	94.6
GS1 system (e.g. e-messaging standards)	7.3	9.3	10.7
GS1 data synchronisation	8.3	7.0	10.7
GS1 electronic product code (EPC) standards	12.5	5.8	10.7
GS1 data bar	4.2	1.2	5.3
GS1 net	11.4	5.8	12.5
GS1 education and training	8.3	7.0	10.7

4.6 Reliability

Reliability of data is concerned about the measurement accuracy. Construct reliability refers to the consistency and stability of a score from a measurement scale (Davis 2005). The validity of a scale relies heavily on it being reliable. Construct reliability is often ascribed to the consistency, precision and repeatability of a study (Kline 2005). There are a number of techniques available for assessing reliability though they are generally categorised into three main methods: test-retest, alternative forms and internal consistency (Davis 2005). The three methods are designed to determine the degree to which systematic or true variance exists in the measurement scales, with all relying on identifying the coefficient of reliability. The coefficient of reliability is a value between 0 to 1.0, with zero indicating no reliability and 1.0 indicating perfect reliability.

For data collected in this study, the internal consistency method was employed. This assesses the correlation for a set of items (Davis 2005). Tests that demonstrate reliability are generally free of random measurement error, producing high values for Cronbach's Alpha (Straub, Boudreau & Gefen 2004). While literature has suggested different acceptable levels for reliability, Hair et al. (2003) suggest 0.6 to 0.7 as the acceptable score and higher than 0.7 as the recommended score. As can be seen in table 4.27, the Cronbach Alpha values for all the factors are relatively high, hence suggesting acceptable reliability of items which make up these factors.

4.7 Validity

The objective of validation is to give confidence to the researcher that the undertaken methods are useful in the search for scientific truth (Straub, Boudreau & Gefen 2004). Accordingly, this study has carried out a number of validity tests: convergent validity, discriminant validity and content validity.

4.7.1 Convergent validity

Convergent validity measures whether items of the same variable or construct measure the same thing and, therefore, reveal correlations to each other. In CFA (confirmatory factor analysis), convergent validity measures whether items of the same latent factor share a proportion of variance (Hair et al. 2003). Convergent validity is, therefore, a direct measure of the extent of the relationship between an observed variable and a latent construct. According to Holmes-Smith (2007), convergent validity is achieved when this relationship, represented by factor loadings, is significantly different from zero. To assess the statistical significance of the factor loading, critical ratios and p-values were calculated for each factor loading. Critical ratios outside the -1.96 to +1.96 z-value range and p-values below $p<0.05$ indicate factor loadings that are significantly different from zero. This statistical test for significance of factor loading is the key criterion in assessing factor validity (Holmes-Smith 2007). Additionally, Hair et al. (2003) have pointed out that another criterion to test for convergent validity is to check whether the standardised loadings are 0.5 or higher, ideally they should be 0.6, 0.7 or higher. When analysing data in this research study, all factor models showed standardised parameter estimates (factor loading), and all loadings were significant. These results suggest that convergent validity is supported by the present data (see sections 4.11 to 4.13).

4.7.2 Discriminant validity

Discriminant validity indicates the extent to which a construct is different from other constructs when theoretically they should not be similar to (Straub, Boudreau & Gefen 2004). In other words, discriminant validity measures the extent latent variables differ from each other. In contrast to convergent validity, which is a measure within latent variables,

discriminant validity is a measure between variables. It is especially important if latent variables and constructs are interrelated. Results of discriminant validity test for the entire model are presented in section 4.15.

4.7.3 Content validity

Content validity deals with the question of whether the instrument (e.g. questionnaire items) is representative of all of the ways that could be used to measure the content of a given construct (Kumar 2005; Straub, Boudreau & Gefen 2004). It is established through the experts' opinion, drawing from existing, validated and accepted instruments, and judgments as well as from the literature review. While a researcher can never guarantee inclusion of all possible items to represent one factor, performing content validity and collecting experts' opinion for the collected items in a study is very valuable (Straub, Boudreau & Gefen 2004). Numan (2005) suggests that to test the validity of the model against experts' opinion, the link between the chosen indicators and definition of the latent construct must be checked. The more experts agree on the fitness of indicators and the definition of the latent construct, the higher the content validity of the model.

Content, or as it is sometimes called, face validity, exists if the items look 'right' and the sample is appropriate (Churchill 1979). The literature review in Chapter 2 discussed previous research that had contributed to the body of knowledge in this research field. Drawing from this theoretical background, a research model was developed. The item development process in Chapter 3 delineated how items were pulled from existing frameworks discussed in the literature and modified (if necessary) through a panel of experts (pre-testing). The above process ensures that the instrument developed for this study has sufficient content validity.

4.8 Overview of factor analysis

To examine the underlying structure among the items of the measurement model, an interdependence technique called factor analysis was employed (Hair et al. 2003; Lewis-Beck, Bryman & Liao 2003). In contrast to dependence techniques which seek to predict a relationship between the independent and the dependent variable, interdependence techniques seek to identify structures, and therefore consider all variables, dependent and independent,

simultaneously (Hair et al. 2003). Hence, factor analysis does not assume any structure or dependence relationship among variables. It is used to reduce the number of theorised items to a smaller number of factors for modelling purposes.

Two main approaches exist for creating and testing the measurement model: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA seeks to discover model structures among items without considering theorised models, and should be used to empirically derive the initial set of factors for the construct (Lewis, Templeton & Byrd 2005). This is especially useful if the relationship between the observed and latent variables is not directly apparent, due to introduction of new research models, or applying research models in different environments (Byrne 2001; Hair et al. 2003). On the other hand, CFA assumes that the research is built on previously theorised items. It is used to determine whether the measured items confirm the expected loadings on factors based on pre-established theory (Byrne 2001). This study uses pre-established research constructs in order to answer the research questions. It adopts CFA for development and testing measurement models. CFA is conducted and fit statistics presented to confirm the measurement model.

4.8.1 Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) models are most commonly used to examine patterns of interrelationships among several constructs. It demands the presence of a theoretical framework, and a priori theory based assumption that defines how each variable loads on each factor and vice-versa. No specific directional relationships are assumed between the constructs, only that they are correlated with one another (Byrne 2001). Consequently, CFA is not concerned with discovering a factor structure, but with confirming the existence of a specific factor structure. It is a general modelling approach that is designed to test hypotheses about a factor structure whose number and interpretation are given in advance. In CFA, the theory comes first, the model is then derived from it, and finally the model is tested for consistency with the observed data using a SEM-type approach (Byrne 2001). Hence, CFA represents what is termed a measurement model. The measurement model is then evaluated for its "goodness-of-fit" to the sample data by statistical means. According to the literature, SEM is the best and most generally accepted procedure for testing both construct validity and the theoretical relationship among constructs (Hair et al. 2003; Kline 2005).

4.9 Goodness-of-fit measurement

Fit indexes reflect the overall fit of the model. It is necessary for researchers to consider the models that represent conceivable means of data description and explanation (Blunch 2008; Raykov & Marcoulides 2006). These can be identified with the use of model fit evaluation. The following sections briefly explain the frequently used goodness-of-fit indices.

4.9.1 Chi-square value (X^2)

This evaluation of model fit is carried out on the basis of an inferential goodness-of-fit index and a number of other descriptive indices. The inferential index is called a chi-square value. It represents a test statistic of the goodness-of-fit of the model and it is used when testing the null hypothesis that the model fits the analysed covariance matrix perfectly (Byrne 2001).

4.9.2 Normed chi-square (X^2/df)

This fit measure is based on the minimum value of the discrepancy. It is the minimum discrepancy divided by its degrees of freedom (CMIN/DF). Generally, a value of less than 3 is good. However, values between 3 and 5 are also acceptable (Kline 2005).

4.9.3 Root mean square error of approximation (RMSEA)

The RMSEA takes into account the error of approximation and is expressed per degree of freedom. This makes it sensitive to the number of estimated parameters in the model. Values of less than 0.08 are acceptable to reflect a reasonably good fit (Browne & Cudeck 1993). Values ranging from 0.08 to 0.10 indicate mediocre fit, and those greater than 0.10 indicate poor fit (MacCallum, Browne & Sugawara 1996).

4.9.4 Tucker Lewis index (TLI)

The TLI estimates the relative improvement per degree of freedom of the target model over an independent model (Hu & Bentler 1998). Generally, a TLI value of greater than 0.90 is considered as acceptable (Kline 2005).

4.9.5 Comparative fit index (CFI)

Comparative fit index (CFI) is defined as the ratio of improvement in non-centrality in the proposed model to the non-centrality of the null model. Typically, the null model is considered to have higher non-centrality than a proposed model because the latter is expected to fit the data poorly (Raykov & Marcoulides 2006). Therefore, values of CFI close to 1 are considered likely to designate a well fitting model. In general, a CFI value of greater than 0.90 is considered as acceptable (Kline 2005).

4.9.6 Normed fit index (NFI)

NFI reflects the proportion by which the proposed model improves the fit compared to the null model. In other words, it indicates the proportion of the improvement of overall fit in the proposed model relative to a null model, by comparing the chi-square value of the proposed model to that of the null model. The null model assumes that there are absolutely no interrelationships between any of the variables. For example, NFI – 0.60 means that the proposed model improves fit by 60 percent compared to the null model. Ideally, the value of NFI should be greater than or equal to 0.90 (Hair et al. 2003; Raykov & Marcoulides 2006).

4.9.7 Descriptive-fit indices

AMOS provides another measure of overall fit which is called the goodness-of-fit index (GFI). This represents the overall degree of fit (the squared residuals from prediction compared to the actual data). GFI is not adjusted for the degrees of freedom. The index is considered a measure of the proportion of variance and covariance that the proposed model is able to explicate (Raykov & Marcoulides 2006). It is concurred that if the number of parameters is also taken into account in computing this measure, the consequential index is called the adjusted goodness-of-fit index (AGFI). Its value ranges value from 0 (poor fit) to 1 (perfect fit). Generally, GFI and AGFI values of greater than 0.90 and 0.80 are considered as acceptable (Hair et al. 2003; Raykov & Marcoulides 2006).

4.10 Provisional codes

Before performing CFA analysis, each construct and its components were coded as follows, using AMOS. Table 4.14 provides the list of all constructs and components, codes and related question numbers which were used in this study.

Table 4.14: List of provisional codes

Construct and component	Code	Question number
Electronic integration	EI	1-11
Electronic information transfer in coordination of decision and operation integration	C1	1-3
Electronic information transfer in managing transaction risk (information sharing)	C2	4-7
Electronic information transfer in managing transaction risk (monitoring and control)	C3	8-11
Human IT resources	HIR	12-15
IT complementary organisational resources	COR	16-25
IT integration strategy	C4	16-18
CEO commitment	C5	19-21
Customer orientation	C6	22-25
Supply chain channel capabilities	SCC	26-34
Information sharing	C7	26-28
Supply chain coordination	C8	29-31
Supply chain responsiveness	C9	32-34
Firm performance	PERF	35-42
Financial performance	C10	35-38
Market performance	C11	39-42

4.11 CFA for IT capability factors

This section examines the confirmatory factor analyses for the three components of IT capabilities in this research namely, electronic integration, human IT resources and IT complementary organisational resources.

4.11.1 CFA for electronic integration (EI)

This construct was measured using three sub-scales: C1= electronic information transfer relating to coordination of decision and operation integration, C2= electronic information transfer relating to managing transaction risk (information sharing), and C3= electronic information transfer relating to managing transaction risk (monitoring and control). As shown in table 4.14 indicates, this factor originally comprised eleven items; however, in order to obtain a good fit, three items (items 3, 6 and 11) were removed because the residual between the items was unacceptable (greater than 2.58) (Byrne 2001; Kine 2005). The final measurement model is depicted in figure 4.1.

Figure 4.1: CFA for electronic integration (EI)

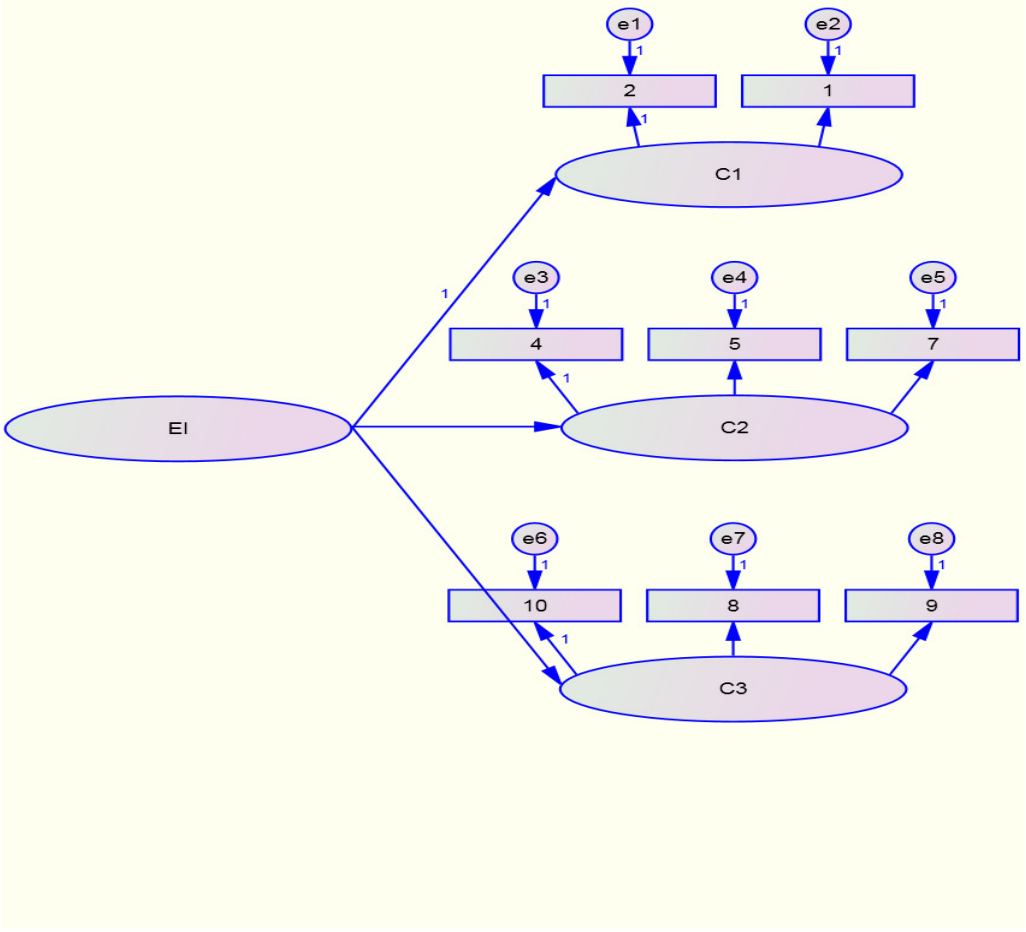


Table 4.15: Model fit index for electronic integration

Fit statistics	Final model fit
Chi-square	20.320 (df: 17, *p*: 0.413)
CMIN/DF	1.195
RMSEA	0.034
GFI	0.970
AGFI	0.937
TLI	0.990
CFI	0.994
NFI	0.965

As the results indicate (table 4.15), the CFI demonstrates a value close to one and therefore suggests that it is a well fitting model with RMSEA <.08 and NFI ≥ 0.90. The construct reliability for electronic integration (EI) is (α) = 0.854. The regression weights for the items of the final measurements model are shown in table 4.16.

Table 4.16: Regression weights for electronic integration

	Estimate	S.E.	C.R.	P
2 ← C1	1.000			
1 ← C1	1.437	0.245	5.874	***
4 ← C2	1.000			
5 ← C2	0.849	0.069	12.278	***
7 ← C2	0.817	0.069	11.921	***
10 ← C3	1.000			
8 ← C3	1.158	0.143	8.108	***
9 ← C3	0.963	0.117	8.212	***

*** Significant at p <0.001 level

There are eight items that indicate a significant relationship. One is the weight assigned to items 2, 4 and 10 in order to obtain a solution. The weights for the last three variables were less than one, but still significant at p<0.001 level.

4.11.2 CFA for human IT resources (HIR)

The final measurement model for human IT resources is depicted in figure 4.2. In order to obtain a good fit, one item (12) was removed because the residual between the items was unacceptable (greater than 2.58). To identify models with only 3 items, two factor loadings were constrained to unity. The constrained loadings were the two items with the smallest difference in factor loadings (Bollen 1989; Kine 2005).

Figure 4.2: CFA for human IT resources (HIR)

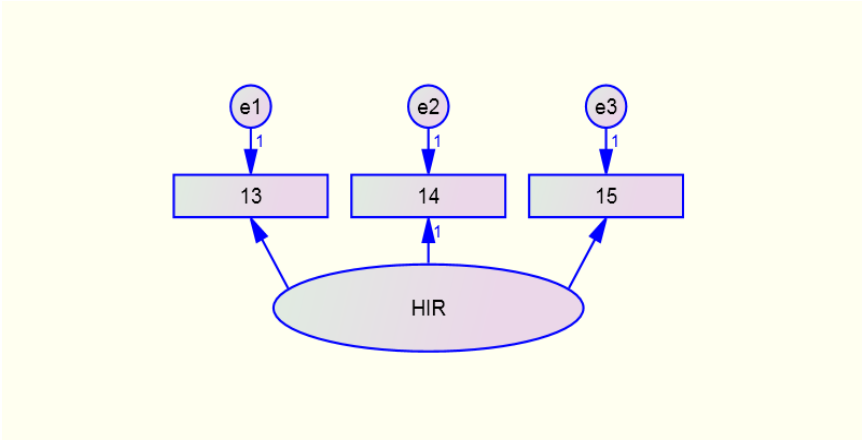


Table 4.17: Model fit index for human IT resources

Fit statistics	Final model fit
Chi-square	0.778 (df: 1, *p*: 0.401)
CMIN/DF	0.778
RMSEA	0.000
GFI	0.997
AGFI	0.982
TLI	1.002
CFI	1.000
NFI	0.998

The regression weights for the three items of the final measurement model are shown in table 4.18.

Table 4.18: Regression weights for human IT resources

	Estimate	S.E.	C.R.	P
14← HIR	1.000			
13← HIR	0.960	0.043	22.538	***
15← HIR	0.960	0.043	22.538	***

*** Significant at p <0.001 level

There are three items that indicate a significant relationship. The weight assigned to item 14 is one in order to obtain a solution. The weights for the remaining two variables were less than one but significant at p<0.001 level. The construct reliability for human IT resources (HIR) is (α) = 0.938.

4.11.3 CFA for IT complementary organisational resources (COR)

This construct was operationalised using three sub-scales (C4=IT integration strategy, C5=CEO commitment and C6= Customer orientation) which had a total of 10 items. In order to obtain a good fit, one item (22) was removed because the residual between the items was unacceptable (greater than 2.58). The final measurement model for IT complementary organisational resources is depicted in figure 4.3.

Figure 4.3: CFA for IT complementary organisational resources (COR)

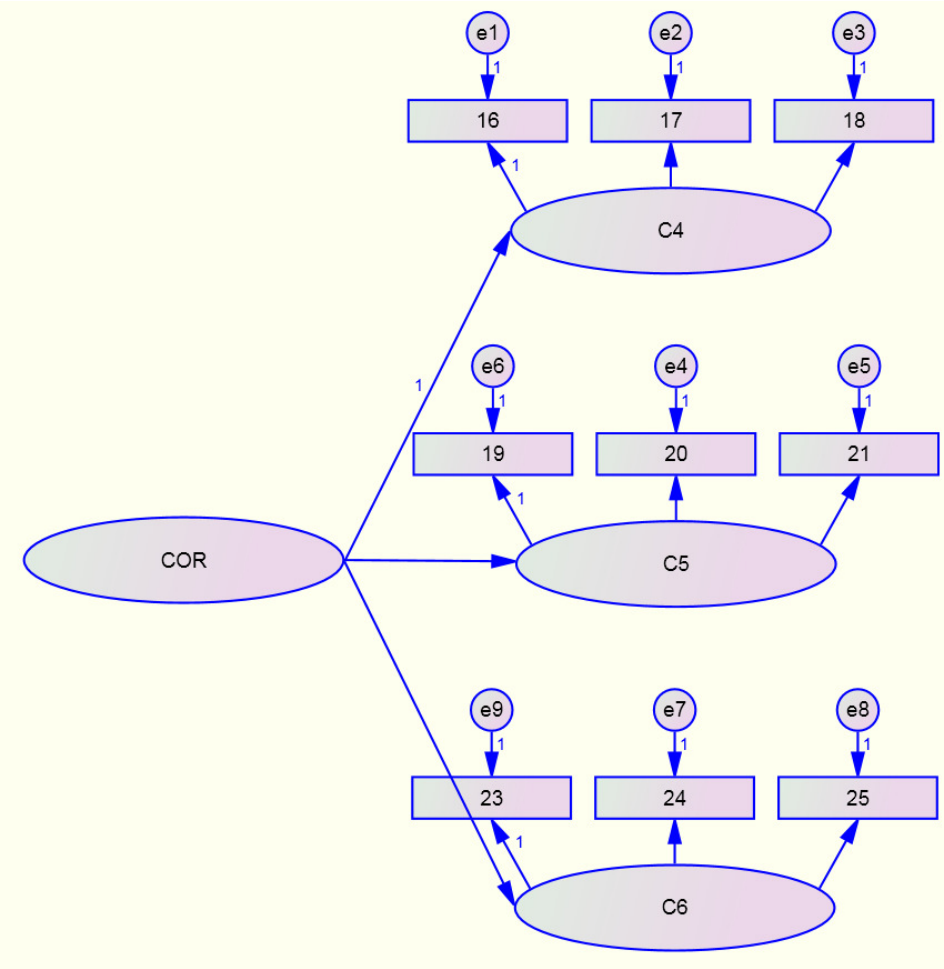


Table 4.19: Model fit index for IT complementary organisational resources

Fit statistics	Final model fit
Chi-square	30.714 (df: 24, *p*: 0.389)
CMIN/DF	1.280
RMSEA	0.041
GFI	0.962
AGFI	0.929
TLI	0.990
CFI	0.994
NFI	0.972

As the results indicate, the CFI demonstrates a value close to one and therefore suggests that it is a well fitting model with RMSEA <.08 and NFI ≥ 0.90. The construct reliability for IT complementary organisational resources (COR) is (α) = 0.880. The regression weights for the items of the final measurements model are shown in table 4.20.

Table 4.20: Regression weights for IT complementary organisational resources

	Estimate	S.E.	C.R.	P
16← C4	1.000			
17← C4	1.230	0.075	16.340	***
18← C4	1.083	0.077	14.147	***
19← C5	1.000			
20← C5	1.044	0.093	11.196	***
21← C5	1.108	0.094	11.852	***
23← C6	1.000			
24← C6	1.084	0.076	14.291	***
25← C6	0.938	0.071	13.226	***

*** Significant at *p* <0.001 level

There are nine items that indicate a significant relationship. One is the weight assigned to items 16, 19 and 23 in order to obtain a solution. The weight for one of the items was less than one, but still significant at *p*<0.001 level.

4.11.4 Full measurement model for IT capabilities

In this study, the IT capabilities were theorised to consist of three components, namely electronic integration, human IT resources and IT complementary organisational resources. The full measurement model for all three components of IT capabilities is presented in Figure 4.4.

Figure 4.4: CFA for IT capabilities

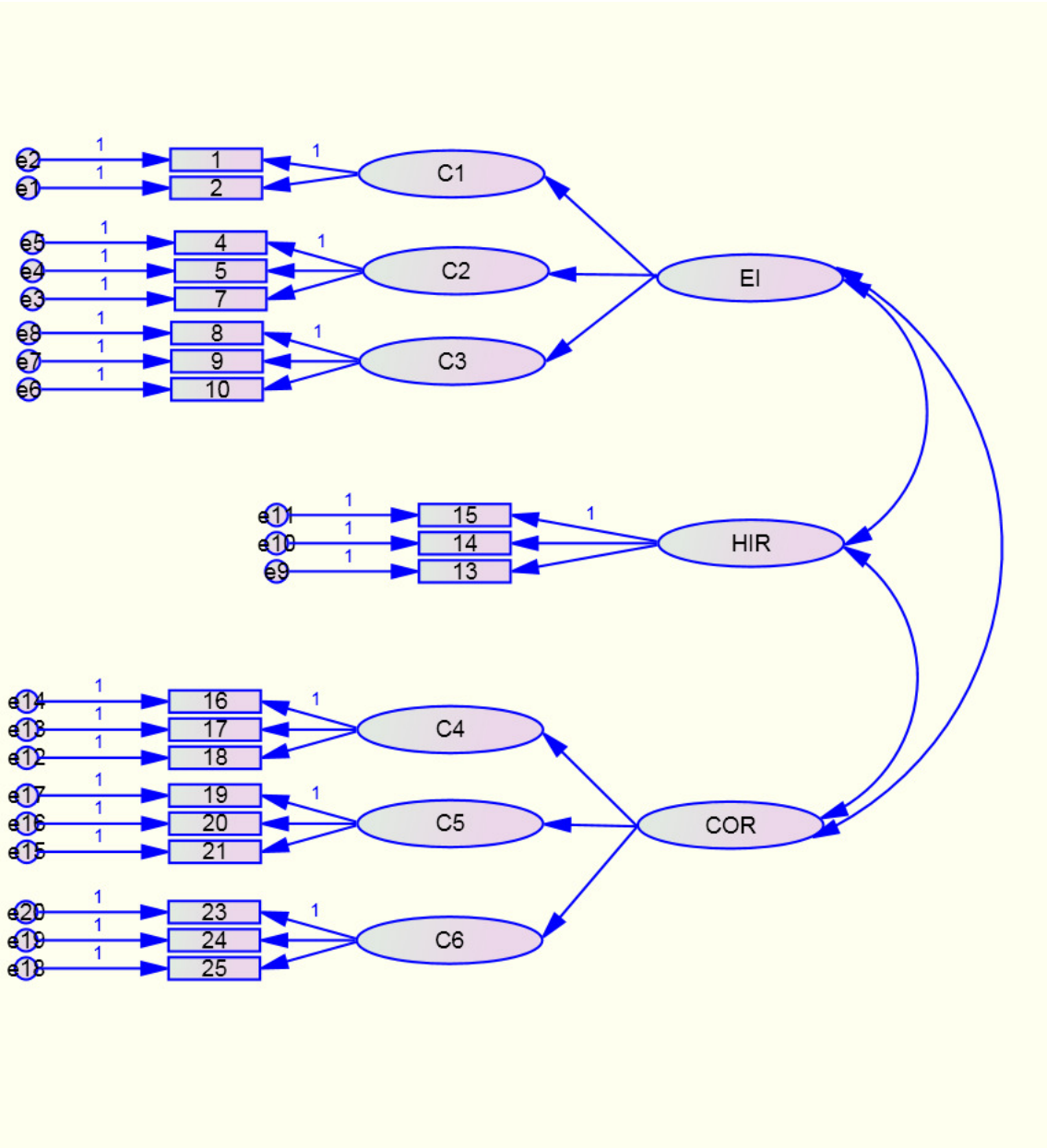


Table 4.21: Model fit index for IT capabilities

Fit statistics	Final model fit
Chi-square	236.625 (df: 161, *p*: 0.056)
CMIN/DF	1.470
RMSEA	0.053
GFI	0.878
AGFI	0.840
TLI	0.959
CFI	0.965
NFI	0.900

Results revealed that the data fits the model (x^2 (161): 236.625, *p*: 0.056). The CFI demonstrates an acceptable value and therefore suggests that it is a fitting model. Other indices of fit as seen in table 4.21 also lend support to the fit of the model. As the results indicate, the NFI represent a good approximation of the data, with RMSEA <0.08. The regression weights for the items of IT capabilities model are shown in table 4.22.

Table 4.22: Regression weights for IT capabilities

	Estimate	S.E.	C.R.	P
16 ← C4	1.000			
17 ← C4	1.198	0.072	16.614	***
18 ← C4	1.078	0.074	14.506	***
19 ← C5	1.000			
20 ← C5	1.045	0.092	11.314	***
21 ← C5	1.093	0.092	11.864	***
23 ← C6	1.000			
24 ← C6	1.081	0.075	14.377	***
25 ← C6	0.930	0.071	13.188	***
13← HIR	1.000			
14← HIR	1.061	0.056	18.856	***
15← HIR	1.050	0.057	18.267	***
1 ← C1	1.000			
2 ← C1	0.672	0.115	5.825	***
4 ← C2	1.000			
5 ← C2	0.857	0.070	12.313	***
7 ← C2	0.822	0.069	11.921	***
8 ← C3	1.000			
9 ← C3	0.819	0.087	9.402	***
10 ← C3	0.868	0.105	8.232	***

*** Significant at p <0.001 level

4.12 CFA for supply chain channel capabilities (SCC)

Supply chain channel capabilities is measured by three constructs (C7= information sharing, C8= supply chain coordination and C9= supply chain responsiveness) all of which have a total of nine items as indicated in table 4.14. The final measurement model is depicted in figure 4.5.

Figure 4.5: CFA for supply chain channel capabilities (SCC)

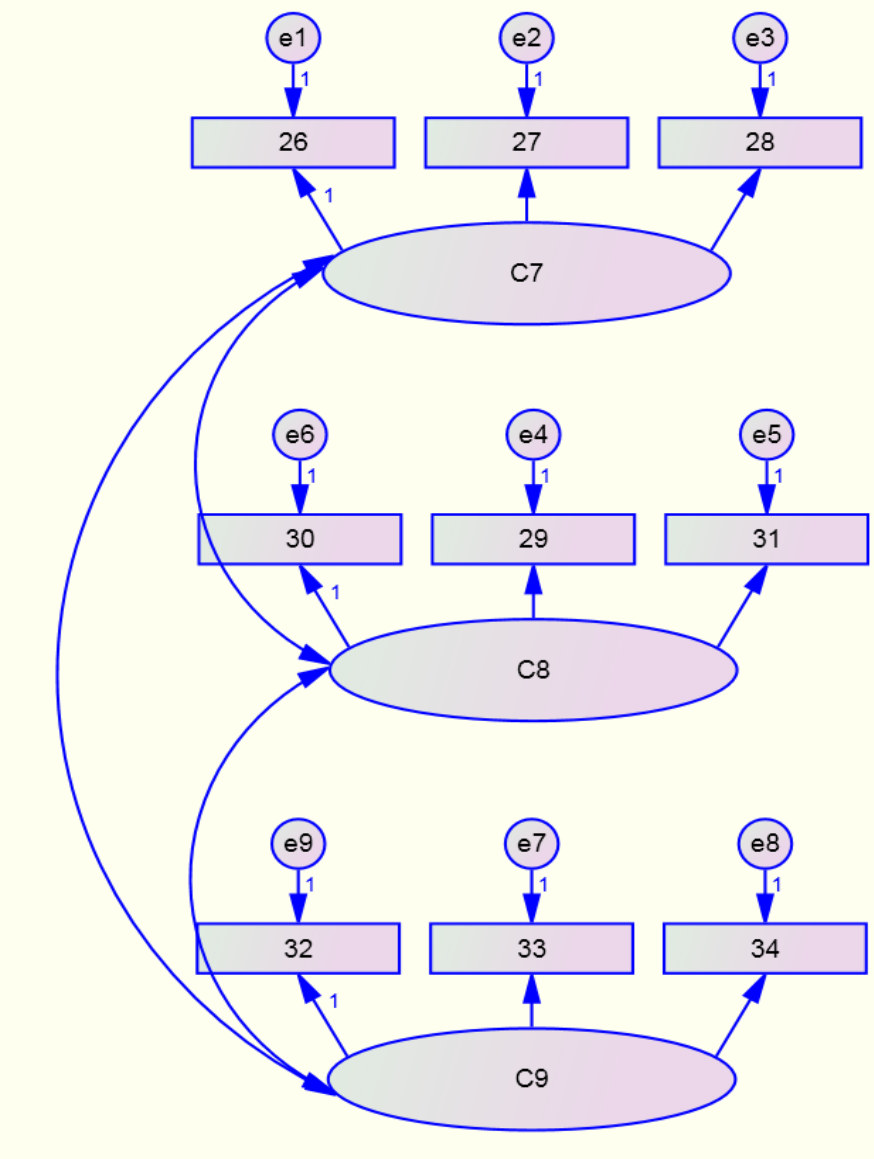


Table 4.23: Model fit index for supply chain channel capabilities

Fit statistics	Final model fit
Chi-square	41.150 (df: 24, *p*: 0.160)
CMIN/DF	1.715
RMSEA	0.065
GFI	0.948
AGFI	0.903
TLI	0.985
CFI	0.990
NFI	0.976

As revealed by results indicate, the GFI and AGFI represent a good approximation of the data, with RMSEA <0.08. The CFI demonstrates a value close to one and therefore suggests that it is a well fitting model. The construct reliability for information sharing (C7), supply chain coordination (C8) and supply chain responsiveness (C9) are (α) = 0.945, (α) = 0.974 and (α) = 0.922 respectively. The regression weights for the items of the final measurements model are shown in table 4.24.

Table 4.24: Regression weights for supply chain channel capabilities

	Estimate	S.E.	C.R.	P
26 ← C7	1.000			
27 ← C7	1.082	0.049	22.192	***
28 ← C7	0.982	0.052	18.709	***
30 ← C8	1.000			
31 ← C8	0.985	0.027	36.723	***
29 ← C8	1.039	0.033	31.302	***
32 ← C9	1.000			
33 ← C9	1.026	0.056	18.332	***
34 ← C9	0.944	0.061	15.487	***

*** Significant at p <0.001 level

There are nine items that indicate a significant relationship. One is the weight assigned to items 26, 30 and 32 in order to obtain a solution. The weights for three variables were less than one, but still significant at p<0.001 level.

4.13 CFA for firm performance (PERF)

Firm performance is measured by two constructs of financial performance and market performance. The results reveal that financial performance (C10) and market performance (C11) has a high correlation. This suggests that a second order construct model is necessary for firm performance consisting of financial and market performance. This factor initially comprised eight items, however, in order to obtain a good fit, item 37 was removed because the residual between the items was unacceptable (greater than 2.58). The final measurement model is presented in figure 4.6.

Figure 4.6: CFA for firm performance (PERF)

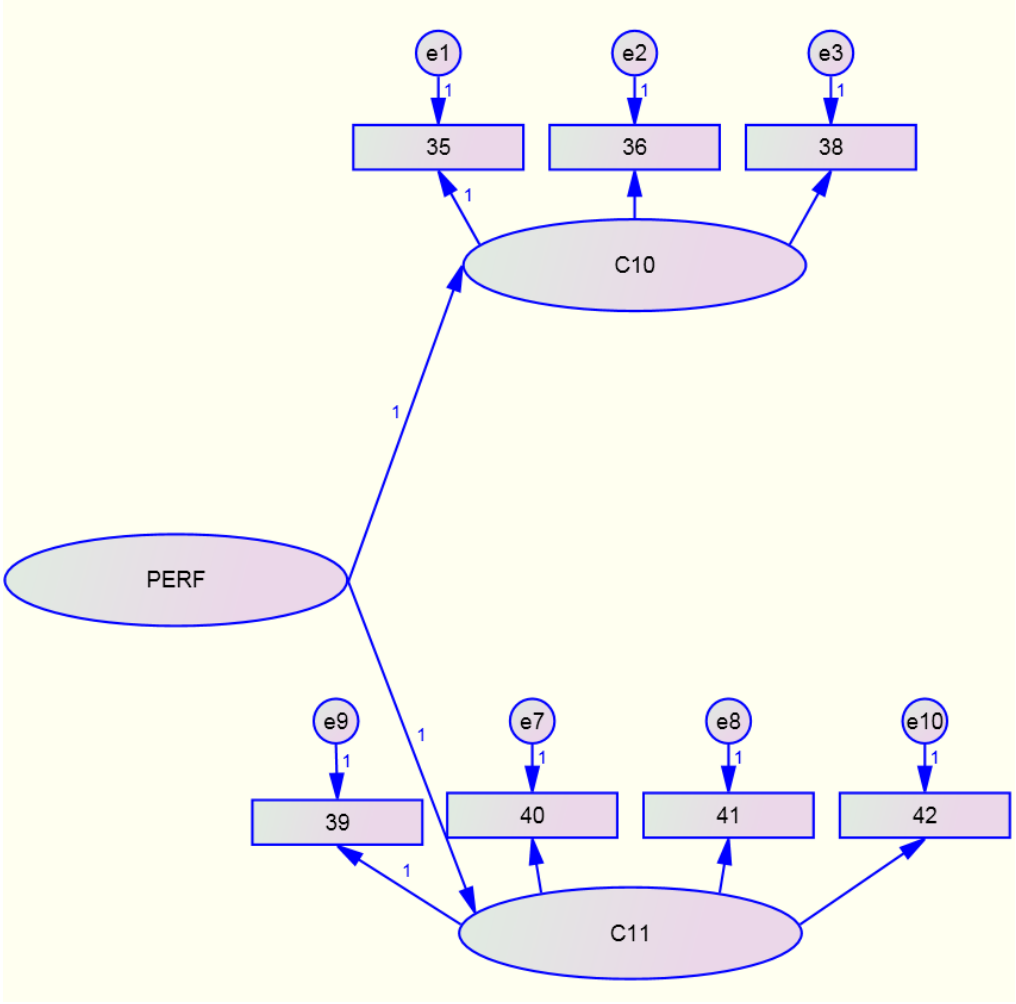


Table 4.25: Model fit index for firm performance

Fit statistics	Final model fit
Chi-square	17.587 (df:13, *p*: 0.649)
CMIN/DF	1.353
RMSEA	0.046
GFI	0.972
AGFI	0.939
TLI	0.996
CFI	0.998
NFI	0.991

As the results indicate, the GFI and AGFI represent a good approximation of the data. The CFI demonstrates a value of close to one and therefore suggests this is a well fitting model. The construct reliability for firm performance (PERF) is (α) = 0.931. The regression weights for the 7 items of the final measurements model are shown in table 4.26.

Table 4.26: Regression weights for firm performance

	Estimate	S.E.	C.R.	P
35← C10	1.000			
36← C10	1.010	0.022	45.375	***
38← C10	0.999	0.026	39.092	***
39← C11	1.000			
40← C11	1.020	0.028	36.223	***
41← C11	0.996	0.034	28.901	***
42← C11	1.009	0.035	28.618	***

*** Significant at p <0.001 level

There are seven items that indicate a significant relationship. One is the weight assigned to items 35 and 39 in order to obtain a solution. The weights for the remaining five variables were also significant.

4.14 Descriptive statistics

Table 4.27 depicts descriptive statistics (mean and standard deviation) and construct reliability for all analysis done so far in relation to the entire model.

Table 4.27: Descriptive statistics

	Mean	Std. Deviation	Construct reliability
Electronic integration (EI)	25.41	10.985	0.854
Human IT resources (HIR)	13.16	4.358	0.938
IT complementary org resources (COR)	40.33	10.298	0.880
Information sharing (C7)	12.73	3.494	0.945
Supply chain coordination (C8)	12.36	3.365	0.974
Supply chain responsiveness (C9)	14.54	3.703	0.922
Firm performance (PERF)	33.09	7.413	0.931

4.15 Discriminant validity

Discriminant validity, as mentioned in section 4.7.2, refers to the principle that the indicators for different constructs should not be so highly correlated as to indicate that they are measuring the same thing. This was done for the entire model. The results show that there is no relatively high inter-correlation between different constructs of the research model. Within each construct, discriminant validities range from 0.648 to 0.987. A summary of the results is shown in table 4.28.

Table 4.28: Discriminant validity

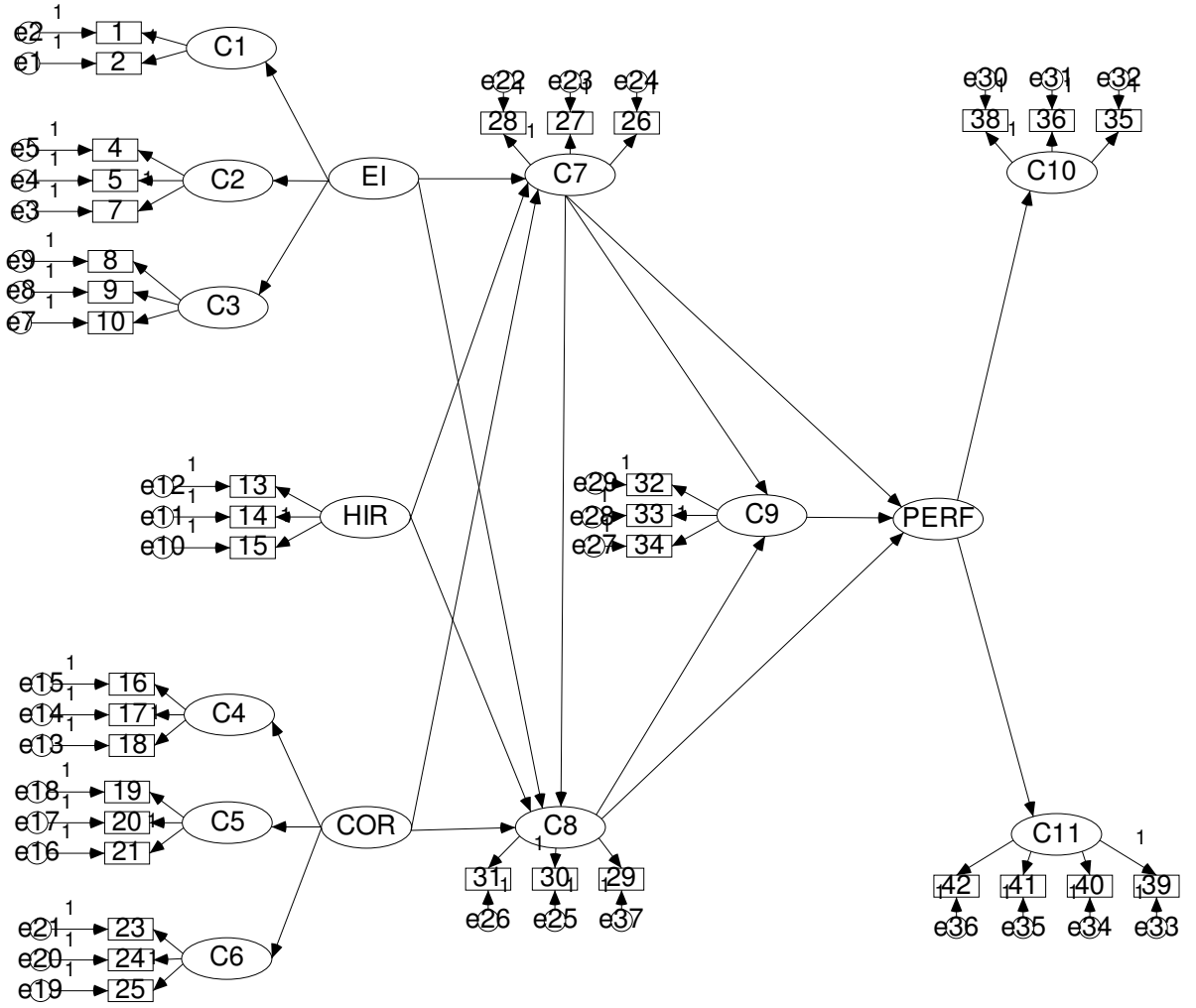
Construct	Item	Discriminant validity
Electronic information transfer in coordination of decision and operation integration (C1)	2 1	.648 .745
Electronic information transfer in managing transaction risk (information sharing) (C2)	7 5 4	.796 .816 .884
Electronic information transfer in managing transaction risk (monitoring and control) (C3)	10 9 8	.671 .796 .790
Human IT resources (HIR)	15 14 13	.916 .924 .900
IT integration strategy (C4)	18 17 16	.858 .941 .860
CEO commitment (C5)	21 20 19	.922 .852 .758
Customer orientation (C6)	25 24 23	.829 .890 .870
Information sharing (C7)	26 27 28	.926 .948 .896
Supply chain coordination (C8)	29 30 31	.944 .981 .965
Supply chain responsiveness (C9)	32 33 34	.905 .931 .848
Financial performance (C10)	35 36 38	.987 .978 .965
Market performance (C11)	42 41 40 39	.939 .940 .974 .965

4.16 Structural equation modelling

Structural equation modelling (SEM) is a statistical technique used in a wide range of fields of research. Its development and application is a major methodological breakthrough in the study of complex interrelations among variables (Jöreskog 1977). SEM is widely recognised as a powerful methodology for capturing and explicating complex multivariate relations in social science data. It represents the unification of two methodological traditions: factor analysis originating from psychology and psychometrics, and simultaneous equations (path analytic) modelling originating from econometrics (Kaplan & Elliott 1997). Hence, the standard SEM is composed of two parts: the measurement model (a sub-model in SEM that specifies the indicators of each construct and assesses the reliability of each construct for later use in estimating the causal relationships) and the structural model (the set of dependence relationships linking the model constructs). Since the measurement properties of each instrument in the current study have already been evaluated through comprehensive reliability analyses and confirmatory factor analyses, the SEM model described in this chapter focuses on path analysis using the AMOS structural model. The significance of each path in the proposed structural model was tested and the overall goodness-of-fit of the entire structural equation model was assessed as well.

To commence the process of SEM, the 5 confirmatory factor analysis models (measurement models) were arranged sequentially as per the conceptual model in figure 2.8 (chapter 2). All items together with their error terms are shown in figure 4.7. This constitutes the initial consolidated SEM model.

Figure 4.7: Detailed initial SEM model



The initial model was used to test the hypotheses, with results as shown in figure 4.8 and tables 4.29 and 4.30. Basically, a version of t-test was employed which uses critical ratios from the SEM. The direction and importance of the relationship is determined by the magnitude of Beta.

Table 4.29: Model fit index for initial model

Fit statistics	Model fit
Chi-square	865.495 (df: 572, *p*: 0.065)
CMIN/DF	1.513
RMSEA	0.055
GFI	0.789
AGFI	0.755
TLI	0.947
CFI	0.952
NFI	0.890

Although the NFI is below an acceptable value, as the results indicate, the RMSEA and CFI represent a good approximation of the data, with RMSEA <0.08 and the CFI demonstrates an acceptable value and therefore suggests the data fits the model.

4.17 Testing of hypotheses

As mentioned in section 4.13, because of high correlation between financial performance and market performance, a second order construct for firm performance consisting of both financial and market performance was conducted. This means that the initial 8 underlying latent constructs were reduced to 7 during the process of CFA. Therefore, the 15 hypotheses in table 2.9 were reduced to 12. The results of the hypotheses tests are shown in table 4.30. All the hypotheses that were supported at $p< 0.05$ are labelled "Yes" in the support column.

Table 4.30: Hypotheses testing

Hypotheses no.	Estimate	S.E.	C.R.	P	Support	Beta
H1a C7← EI	0.188	0.086	2.188	0.029	Yes	0.200
H1b C8← EI	0.145	0.088	1.661	0.097	No	0.157
H1c C7← HIR	0.191	0.069	2.770	0.006	Yes	0.237
H1d C8← HIR	0.075	0.070	1.067	0.286	No	0.094
H1e C7← COR	0.417	0.122	3.408	***	Yes	0.406
H1f C8← COR	0.200	0.129	1.544	0.123	No	0.196
H2a C8← C7	0.270	0.099	2.723	0.006	Yes	0.272
H2b C9← C7	0.267	0.087	3.071	0.002	Yes	0.257
H3ab PERF← C7	0.193	0.084	2.284	0.022	Yes	0.250
H2c C9← C8	0.382	0.087	4.391	***	Yes	0.366
H3cd PERF← C8	0.145	0.086	1.683	0.092	No	0.187
H3ef PERF← C9	0.163	0.082	1.997	0.040	Yes	0.219

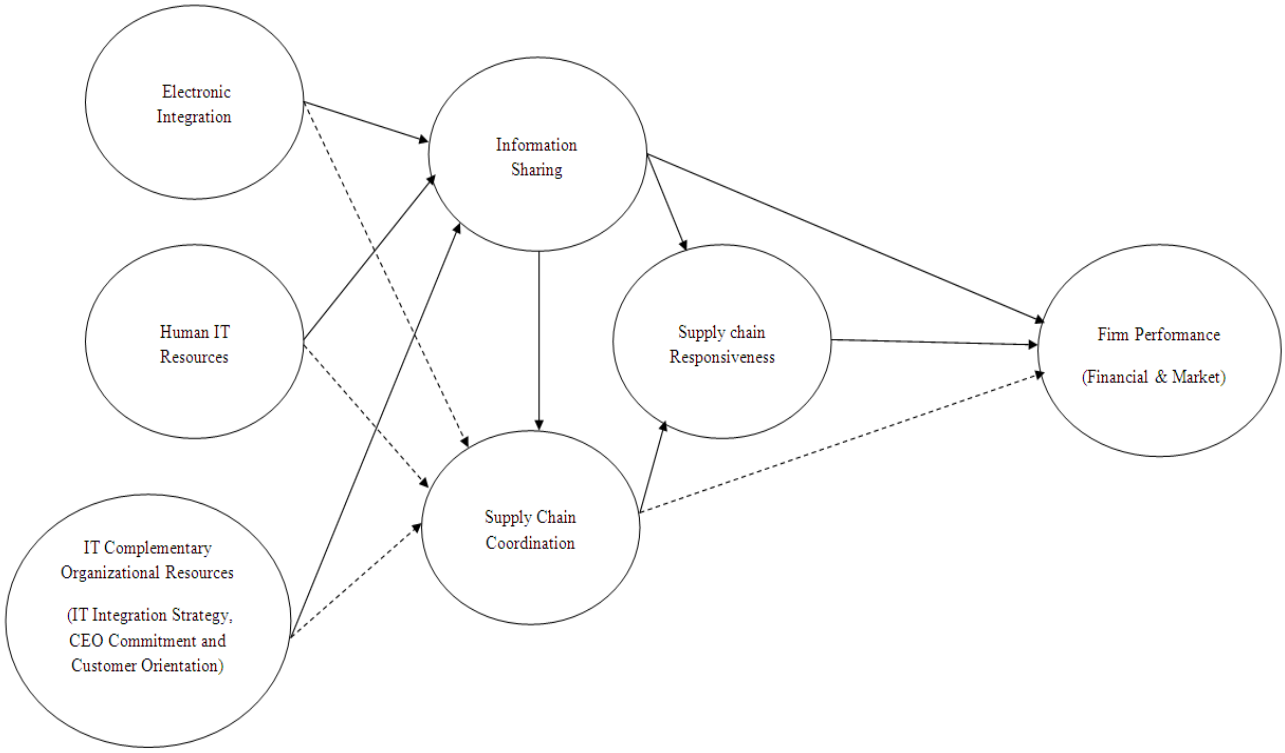
*** Significant at p <0.001 level

The standardised regression weights (Beta values) for the twelve hypotheses are shown in table 4.31. Beta values range from 0.094 to 0.406.

Table 4.31: Standardised regression weights for constructs

	Estimate
Electronic integration→ Information sharing	0.200
Electronic integration→ SC Coordination	0.157
Human IT resources→ Information sharing	0.237
Human IT resources→ SC coordination	0.094
IT Complementary org resources→ Information sharing	0.406
IT Complementary org resources→ SC coordination	0.196
Information sharing→ SC coordination	0.272
Information sharing→ SC responsiveness	0.257
Information sharing→ Firm performance	0.250
SC coordination→ SC responsiveness	0.366
SC coordination→ Firm performance	0.187
SC Responsiveness→ Firm performance	0.219

Figure 4.8: Initial model to test hypotheses



4.18 Discussion of hypotheses tests

The following section comprises a discussion relating to the hypotheses which were tested.

4.18.1 Electronic integration

H1a: Electronic integration is positively related to information sharing.

H1b: Electronic integration is positively related to SC coordination.

Electronic integration which in this study particularly focuses on electronic information transfer has three sub-scales each relating to information transfer for 1) coordination of decision and operation integration, 2) managing transaction risk (information sharing) and 3) managing transaction risk (monitoring and control). Hypothesis H1a was accepted and hypothesis H1b was rejected. The results indicate that electronic integration has a direct

positive influence on information sharing but not on SC coordination. This means that the level of electronic information transfer between a firm and its supply chain partners provide a closer integration between a firm and its SC partners for sharing information. However, the results do not support that this electronic integration also has a direct positive effect on coordination activities between a firm and its SC partners.

4.18.2 Human IT resources

H1c: Human IT resources are positively related to information sharing.

H1d: Human IT resources are positively related to SC coordination.

Human IT resources in this study, including technical skills and managerial knowledge, have been regarded as important IT capabilities in prior studies (Bharadwaj 2000). Hypothesis H1c was accepted and hypothesis H1d was rejected. The results indicate that human IT resources have a direct positive impact on information sharing but do not have the same direct impact on SC coordination.

4.18.3 IT Complementary organisational resources

H1e: IT Complementary organisational resources are positively related to information sharing.

H1f: IT Complementary organisational resources are positively related to SC coordination.

IT complementary organisational resources refer to organisational resources which are complementary to IT infrastructure and B2B integration. IT Complementary organisational resources in this study comprise three components namely, IT integration strategy, CEO commitment and customer orientation. Hypothesis H1e was accepted and hypothesis H1f was rejected. Therefore, the results show that IT complementary organisational resources were positively related to information sharing but not to SC coordination.

4.18.4 Supply chain channel capabilities

H2a: Information sharing is positively related to SC coordination.

H2b: Information sharing is positively related to SC responsiveness.

The findings indicate that both hypotheses H2a and H2b were accepted. This reveals that information sharing with the support of IT capability has a direct positive influence on SC coordination and SC responsiveness. This result supports the work of Bowersox, Closs & Stank (1999) who propose that information sharing directly contributes to channel capabilities such as coordination and responsiveness of the partnership.

H2c: SC coordination is positively related to SC responsiveness.

Hypothesis H2c was accepted. This implies that SC coordination with the support of information sharing has a direct positive association with SC responsiveness and illustrates that SC coordination enhances SC responsiveness by helping channel partners accommodate market changes or customer requests in a timely manner.

4.18.5 Firm performance

H3ab: Information sharing is positively related to firm performance.

The results show that hypothesis H3ab was accepted. This suggests that information sharing has a direct positive influence on a firm's performance. In other words, IT capabilities help partners share more information, as information sharing improves their efficiency in gathering accurate, necessary and timely data (Rogers, Daugherty & Stank 1993). Therefore, this improvement in information sharing has a direct positive impact on market and financial outcomes such as profitability, return on investment (ROI), cash flow from operations, total cost reduction, sales growth, market share, market development and customer service level.

H3cd: SC coordination is positively related to firm performance.

The results indicate that hypothesis H3cd was rejected. This illustrates that SC coordination does not have a direct positive influence on a firm's performance. Coordination with supply chain partners encompasses the coordination of materials, money, manpower and capital equipment from order taking to order follow-up (Sahin & Robinson 2002). The results reveal

that IT capabilities indirectly through information sharing does not increase and improve firm performance through SC coordination.

H3ef: SC responsiveness is positively related to firm performance.

The findings clearly demonstrate that hypothesis H3ef was accepted. This shows that SC responsiveness has a direct positive influence on a firm's performance. This means that IT capabilities directly through information sharing and indirectly through SC coordination have a positive influence on SC responsiveness. As a result, SC responsiveness, which refers to a firm's quick and effective cooperative reaction to changes in the environment and market, has a direct impact on a firm's market and financial outcomes such as profitability, cost reduction and customer satisfaction.

4.19 Examining the model (final best-fit model)

The respecified model is shown in figure 4.9. The weak relationships (beta<0.2) were removed to provide a better fit. Additionally, the standardised residuals for q9 and q32 were too large (>2.58) therefore these variables were removed (Byrne 2001). Eventually, a reasonably better fit was obtained as shown in the model in figure 4.9 and tables 4.32 and 4.33.

Figure 4.9: Final best-fit model

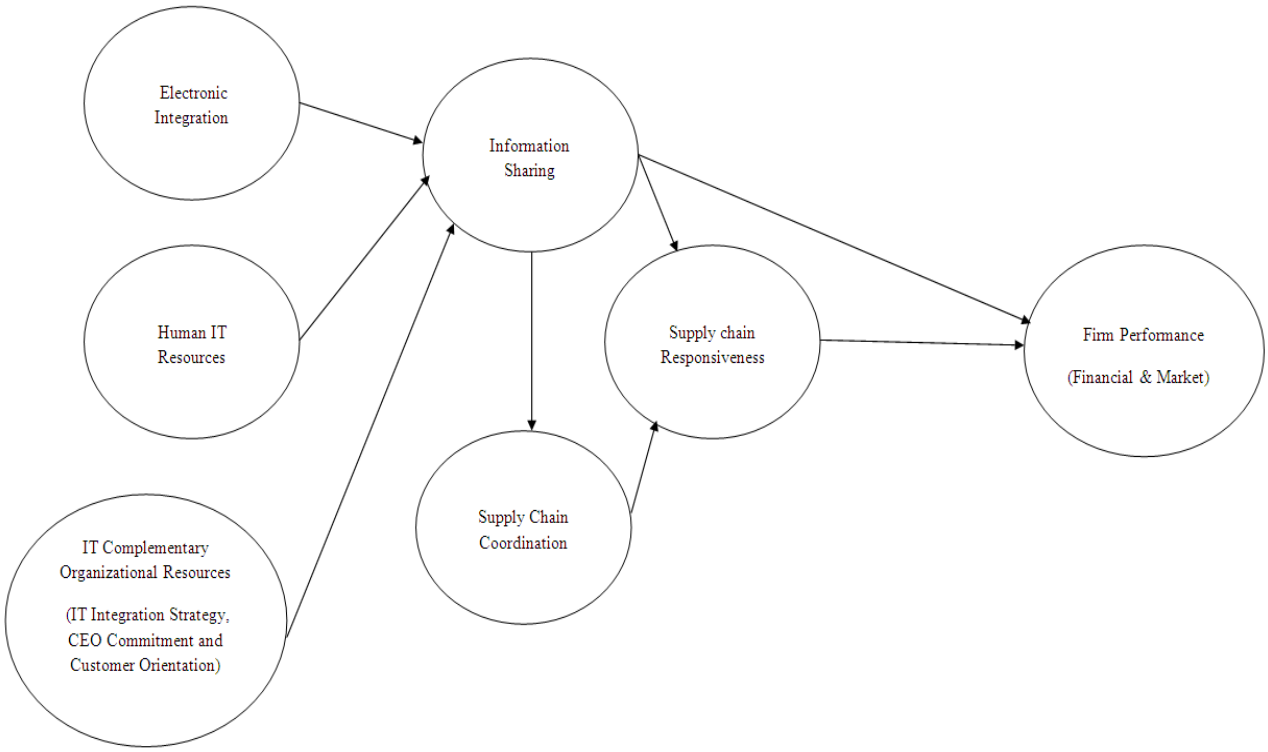


Table 4.32: Model fit index for final best-fit model

Fit statistics	Model fit
Chi-square	770.752 (df:509, *p*: 0.051)
CMIN/DF	1.514
RMSEA	0.055
GFI	0.803
AGFI	0.769
TLI	0.950
CFI	0.957
NFI	0.899

Results revealed that the data fits the model (x^2 (509): 770.752, *p*: 0.051). The model fit indices were improved. CFI = 0.957 and NFI= 0.899 were all better than the initial model. As mentioned, the hypotheses with beta under 0.2 were removed to provide a better fit. Therefore, the 12 hypotheses in the initial model were reduced to 8. All hypotheses are supported. Summary of testing hypotheses results provided in table 4.33.

4.20 Summary of the hypotheses test for the research model

A summary of testing all research hypotheses results is provided in table 4.33.

Table 4.33: Summary of testing hypotheses results

Hypothesis	Results
Electronic integration is positively related to information sharing.	Supported
Electronic integration is positively related to SC coordination.	Rejected
Human IT resources are positively related to information sharing.	Supported
Human IT resources are positively related to SC coordination.	Rejected
IT complementary organisational resources (IT integration strategy, CEO commitment and customer orientation) are positively related to information sharing.	Supported
IT complementary organisational resources (IT integration strategy, CEO commitment and customer orientation) are positively related to SC coordination.	Rejected
Information sharing is positively related to SC coordination.	Supported
Information sharing is positively related to SC responsiveness.	Supported
SC coordination is positively related to SC responsiveness.	Supported
Information sharing is positively related to firm performance.	Supported
SC coordination is positively related to firm performance.	Rejected
SC responsiveness is positively related to firm performance.	Supported

4.21 Summary

The overall objective of this chapter was to obtain has been to obtain support for the hypothesised models by statistically testing them. The choice of SEM as the main technique used to test the hypothesised models has also been discussed. The initial model was used to test the hypotheses and was then modified to provide a better fit with the data. The analysis revealed that electronic integration, human IT resources and IT complementary organisational resources all have a direct positive impact on information sharing but not on SC coordination. Information sharing has direct positive influence on SC coordination and both of them have a positive impact on SC responsiveness. The results also reveal that information sharing and SC coordination can improve and have positive impact on a firm's performance which in this study is represented by financial and market performances.

Chapter Five

Conclusion, Discussion and Recommendations

5.1 Introduction

The previous chapter analysed the quantitative data obtained from the survey questionnaire's results. This chapter begins with an overview of the research objectives and the gap in the literature in relation to the business value of IT in supply chain relationships. It then provides a summary of research key findings and discussion, major contributions to theory, practice and managerial implications, limitations of the research and, finally, recommendations for future research.

5.2 Research overview

Rising global competition, shifting power to customers, a changing marketplace and a growing dependence on information and communication technology are compelling companies to re-evaluate how best to leverage the functions, processes and relationships that support their businesses and improve their performance (Ireland 1999). Information communication technologies seem to have had a considerable impact on business performance in recent decades. However, research investigating the value gained from these entities coupled with other firm resources is still underdeveloped and problematic.

The emergence of electronically enabled supply chains has changed both the quantity and the velocity of information flowing among supply chain partners. Electronically enabled supply chains use information technologies, such as electronic data interchange (EDI) and the Internet (e.g. email and web site), to enable and enhance supply chain processes, creating efficiencies in the flow of materials and goods (Yao, Palmer & Dresner 2007). Although a variety of advantages of B2B communication technologies are mentioned in the literature, several high-profile e-business initiatives fail to deliver superior performance results (Eng 2004). Referred to as "IT productivity paradox", IT investments often yield negative or zero

returns, posing a challenge for supply chain partners attempting to deploy e-business technologies effectively (Dehning & Richardson 2002; Osmonbekov, Bello & Gilliland 2009). For example, in a study by (Kettinger et al. 1994), 24 out of 30 firms reported negative results of IT investment on market share or profits within five years of IT deployment. Another study of retailers by Powell and Dent-Michallef (1997) also found no effect of both in-store IT and beyond-store IT on overall store performance. Furthermore, the recent disappointing results of IT investment raise questions about the critical role of IT within a firm or supply chain (Kim, Cavusgil & Calantone 2005).

In recent years, the numbers of studies about the impact of IT on supply chain relationships and performance have increased. Some related issues are discussed in different disciplines such as in marketing (Kim, Cavusgil & Calantone 2006), supply chain (Sanders 2005), information system (IS) (Rai, Patnayakuni & Seth 2006) and strategy literatures (Kim & Mahoney 2006). On the other hand, empirical evidence on this issue is still fragmented and a comprehensive conceptual framework to integrate different theoretical perspectives is lacking in the literature (Gunasekaran & Ngai 2004). In particular, there is a lack of academic investigation on how and why information technology can improve supply chain relationships and consequently lead to performance gains.

This study explores the role of IT in channel relationships and firm performance in the context of electronic integration between a firm and its SC partners, seeking plausible explanations for the IT paradox in the literature. The aim of this study is to conceptualise and investigate the issues related to business value of IT in SCM. Although prior research has demonstrated that IT usage does have beneficial performance and productivity impacts, theoretical frameworks are yet to explain how and why this usage enhances firm performance. Thus, the goal of this thesis is to extend current knowledge on whether and how IT usage in supply chain channel capabilities impacts firm performance.

5.3 Addressing research questions and the key findings

This section reviews and addresses the research questions using the key findings from the previous chapter.

1. Whether and how the IT capabilities interact with supply chain channel capabilities create competitive advantage?

This study provides supporting evidence to the conceptual and prescriptive literature about previously inconclusive statements regarding the IT productivity paradox and the relationship between information technology utilisation and a firm's competitive advantage. The results show that a higher level of information technology utilisation (IT capabilities) lead to a greater level of SC responsiveness through two main inter-organisational capabilities (information sharing and SC coordination). The results suggest that supply chain capabilities are able to transform IT-related resources into higher value for a firm. By embedding IT into a company's supply chain systems and processes, the company is capable of enhancing channel specific assets using effective information sharing with supply chain partners. This improvement in information sharing increases and improves effectiveness of SC coordination activities between a firm and its supply chain partners. A superior level of SC channel capabilities provides an information advantage over competitors through gaining access to and even integrating knowledge from multiple sources that are not available when acting alone. The improvement in SC channel capabilities (information sharing and SC coordination) using IT enables industries dealing with innovative products, to learn and respond to market changes better and quicker (SC responsiveness) than other supply chains (competitors).

2. Whether and how the IT capabilities interact with supply chain channel capabilities enhance firm performance?

The empirical analysis examines the association between superior IT capability and superior firm performance and finds the relationship to be positive. The empirical findings show that IT capability is generated from resources that are not easily imitated or substituted. Supporting mechanisms such as alignment between IT strategy with business strategy, IT

technical skills and managerial knowledge, being customer orientated and CEO (top management) IT support and commitment along with electronic integration between a firm and its SC partners allow firms with high IT capability to achieve and sustain superior performance. The analysis suggests that information sharing and supply chain responsiveness among industries dealing with innovative products, can enhance firm performance directly with the help of IT capability. However, the results of this thesis do not support the direct relationships between supply chain coordination and firm performance. Although the results show that IT capabilities increase and improve effectiveness of SC coordination activities indirectly through information sharing, this does not lead to enhancement in firm performance through SC coordination. This means that, these industries without providing the effective coordination platform and processes for using IT and IT capability are unable to enhance firm performance through SC coordination.

5.4 Discussion of the main findings

This section provides a detailed discussion of the result of this study by comparing the major findings to the extant literature.

5.4.1 Impact of IT capabilities on information sharing and SC coordination

5.4.1.1 Electronic integration

Electronic integration can be defined as "the integration of business processes of two or more independent organizations through the exploitation of the capabilities of computers and communication technologies'' (Venkatraman & Zaheer 1994). Electronic integration encompasses a range of inter-firm channel activities from loose transaction activities to tightly coupled ERP to ERP connections to facilitate activities such as collaborative demand planning and fulfilment (Chatterjee, Segars & Watson 2006; Mukhopadhyay & Kekre 2002) and therefore can show varying results on business processes and structures in supply chain relationships.

The results of this study indicate that electronic integration, and particularly electronic information transfer of supply chain related activities between a firm and its SC partners, has a direct positive impact on information sharing. These results support previous studies such as those by Kim, Cavusgil & Calantone (2006), Wu et al. (2006) and Auramo (2005)

pertaining to the informational benefits of IT on information sharing among supply chain members.

In general, the informational benefits of electronic integration are categorised into information access, information quality and information flexibility (Mirani & Lederer 1998). Enhanced information access provides supply chain decision makers with easier and/or faster access to internal and external information. Information quality makes the available information more reliable, accurate and useful. It improves the value of information for strategic planning and operational control. Information flexibility helps decision makers to easily manipulate the content and format of retrieved information (Mirani & Lederer 1998). With the help of electronically enabled supply chains, companies are able to overcome information asymmetries by making information more visible to market participants, leading to relationships being less subject to opportunistic behaviour (Yao, Palmer & Dresner 2007).

According to the European e-business report in 2004 (cited in Mohamed 2008), the major objective that drives companies (regardless of their size) to implement e-business is increasing the efficiency of business processes such as reducing processing costs in relation to commercial transactions. Nevertheless there have always been debatable issues in e-business investment related to higher fixed costs for technology implementation and maintenance among small sized companies. A recent study in Europe indicates that larger companies which can afford more powerful solutions are more likely to take advantage from efficiency gains. In the innovation diffusion literature, firm size is one of the most important factors which was studied (Zhu, Kraemer & Dedrick 2004). Therefore, several important aspects of the organisation are related to firm size such as resource availability, decision agility and prior technology experience (Zhu & Kraemer 2005).

In terms of the impact of electronic integration on SC coordination, the results reveal that electronic integration does not have a direct positive impact on SC coordination. Participants in the SC professionals' interviews (Appendix 4) disclosed some of the limitations and boundaries in relation to direct positive impact of electronic integration on SC coordination in an Australian context. Some of these limitations are related to factors such as firm size (small size with minimum level of IT resources, knowledge and experience) and costly process change for implementing B2B communication technologies.

Sanders (2007) suggests that coordination is not synonymous with usage of e-business technology. Coordination is a result of human interactions which can only be supported by IT, but not replaced. There is also evidence from the literature suggesting that adoption and integration of both traditional (e.g. electronic data interchange) and emerging (e.g. Internet based) technologies depends on factors such as structure, strategic alignment, financial resources, levels of environmental uncertainty, pressure from trading partners and the difficulty of many integration projects (Fawcett & Magnan 2002; Patterson, Grimm & Corsi 2003; Power & Simon 2004).

Additionally, it is highlighted that the degree to which processes have been integrated with SC partners has a direct link to effective applications of B2B communication technologies by a company (Cagliano, Caniato & Spina 2003). There is a particular emphasis on the significance of combining the practice of sharing information (e.g. making data and information available and accessible) with SC partners, with the capability to share (e.g. actual technological integration) (Garcia-Dastugue & Lambert 2003). Hence, as B2B communication technologies are applied more widely among SC members, and process integration with SC partners is more readily enabled, the governance structure defining these relationships comes into focus (Power & Singh 2007).

There are a number of choices which a firm has in relation to the type and nature of relationships it intends to have with its SC partners. The "arm's length" model has been often followed in supplier relationships by using multiple vendors, constant price reviews and short-term (or minimal) commitments. The rationale for this approach has been to contradict what Porter has explained as sources of bargaining power of suppliers (Porter 1998; Porter & Millar 1985). This approach has found theoretical rationalisation in the use of markets as governance structures reducing the potential for opportunism on the side of SC partners (Williamson 1975). In contrast, the partner model in the context of supplier relationships supports the sharing of information (and/or assets) between SC partners, leveraging areas of common interest and combined competitive advantage (Power & Singh 2007).

B2B communication technologies, especially emerging Internet enabled technologies, are promoted as being a critical factor enabling companies to integrate disparate legacy systems

(Kim & Narasimhan 2002). On the other hand, these technologies can create an increased need for further integration (Croom 2001). Using perspective of transaction cost economics, these issues could be considered as coordination costs relating to developing new or adoptive governance structures. The problem this creates is that companies implementing these technologies are faced with an increasing requirement to connect disparate systems across functions and/or between SC partners, or be faced with significant constraints on potential results. As companies assign more resources to the integration of legacy systems, it can be expected that they will also be faced with limitations inherent in the integrity, timeliness and accuracy of existing data. The assumption that utilisation of these technologies in electronic integration will decrease transaction costs, for example, by neutralising information search and access costs which may as a result be seen to be simplistic (Power & Singh 2007).

It is argued that the need to link systems and ensure quality of data for using B2B communication technologies is the need to re-engineer processes (Mohanty & Deshmukh 2000; Reutterer & Kotzab 2000) or even to develop new structure and business models (Bruce, Daly & Towers 2004). The relationship between use of new technological forms and structural change within companies could be understood as creating a positive reinforcing loop where greater levels of usage lead the requirement for more essential change to governance structures, possibly increasing transaction costs (at least in the short term) (Huber 1990).

5.4.1.2 Human IT resources

Technology cannot operate in a vacuum. Adequate and competent technical skills and knowledge are necessary for managing and leveraging advanced B2B communication technologies. In previous studies, human IT resources including technical skills and managerial knowledge have been considered as essential IT capabilities (Fink & Neumann 2007). Byrd and Turner (2001) determined that IT professionals with higher technical and managerial skills led to better IT infrastructure flexibility, a feature of strategic importance to IT and business managers (Byrd & Turner 2000). They also determined that these skills enhanced the competitive advantage in main business management areas (Byrd & Davidson 2003). Harkness, Kettinger and Segars (1996) found that Bose Corporation had to improve the depth and scope of the skills of its IT employees in order to develop an integrated

infrastructure for better supply chain relationships. Mata, Fuerst and Barney (1995) noted that the skills of the IT professionals were essential in order to maintain a sustained competitive advantage for an organisation's IT resources.

From a RBV standpoint, several studies have found that human IT resources are rare and difficult to acquire and therefore could be a source of a firm's competitive advantage. For instance, in empirical research by Kim, Cavusgil and Calantone (2006) in the supply chain context, the accumulation of internal IT skills and knowledge in the company enhances inter-firm coordination and information exchange directly. Hence, in this study, human IT resources is considered as the main IT capability which can help companies successfully manage their supply chain activities and achieve greater business value.

The results show that human IT resources have a direct positive impact on information sharing. Determining effective IT systems and technologies, establishing IT platform, and developing, upgrading and maintaining IT systems and the company's web site are some of the factors which were mentioned by the participants in the SC professionals' interviews. The results also reveal that human IT resources do not have a direct positive impact on SC coordination. Most participants in the SC professionals' interviews cited various issues and barriers associated with the direct impact of human IT resources in their SC coordination activities. These issues include the high cost related to establishing advanced IT systems and technologies in their companies, the process change (or structure change) difficulties, lack of support in using effective IT technologies with external parties, and lack of appropriate IT corporate policy in providing services (technologies) which are required for their current SC operations.

IT usage intensity in supply chain relationships is one of the factors that may influence a firm's technology adoption for operations (Zhang & Dhaliwal 2009). This encompasses all types of IT usage by a firm's partners, suppliers, customers and competitors when the technology is adopted and deployed for various supply chain operations. Greater IT usage intensity in supply chain relationships entails greater technological readiness (Zhu & Kraemer 2005) in relation to both technology infrastructure and human IT resources. This can make it easier for a particular firm to adopt new technologies to deal with its SC partners. Zhu et al. (2006) argued that the trading community influence is a main driver of SC

relationships effects which is a determinant of B2B communication technologies. Due to the increased use of IT among players in the SC, firms need to deal with heavier normative pressure to adopt technology applications with SC partners for a better return on technology investment and effectiveness (Teo, Wei & Benbasat 2003). As a result, the higher the IT usage by industry players, the more likely will be a firm's external diffusion of technology for supply chain operations (information sharing and SC coordination).

According to Asproth and Nystrom (2008), there is a gap between the maturity levels of enterprises and their use of IT. Technologically mature enterprises utilise the technology in a natural way and the technology is, in some sense, experienced as being seamless. For example, the users are focused on the aim of communication for the purpose of SC integration rather that accumulation of ongoing units of technology such as web cameras, microphones, communication programs, chat functions and so on. Asproh and Nystrom (2008) also identified some of the issues enterprises have in using Internet communication technologies with external partners such as unclear communication strategy or lack of company involvement in the Internet challenge, for instance, poorly matured web sites and absence of strategy pertaining to usage of the Internet in a strategic manner, organisational change and the increased importance of updated web sites.

The results show that the majority of respondents (64.5 percent) had fewer than 50 employees. Hence, small and medium sized companies (SMEs) have relatively lower levels of finance and human resources and capabilities for investment and using communication technologies in relation to their SC partners. Some of these companies have minimum IT staff or have already outsourced their human IT to IT solution providers.

Evidence from previous literature on using IT in SMEs revealed that small companies are far less likely to use new technologies than larger firms. Levy, Powell and Yetton (2001) emphasise that few small sized companies make innovative uses of Internet technologies. According to Baines and Weelock (1998), they often rely too heavily on family members rather than exploit others' skills and expertise in relation to using technology. Mehrtens, Cragg and Mills (2001) found that there are three key factors that influence small sized companies' decisions about e-business technology investment: perceived benefits, organisational readiness and external pressures (Harland, Caldwell, Powell & Zheng 2007).

Based on the findings, email and the Internet are the most common communication technologies which are used by companies in the survey sample. All of the participants use email and 79.3 percent use web sites for publishing product and services information. According to Konh and Maguire (2004), information integration applications such as ERP are less suitable to small sized companies which tend to integrate tactical and cultural knowledge rather than explicit knowledge. On the other hand, the stand-alone web sites for conveying product and services information were designed as one-way communication (pushing information). Communication through e-mail should possibly be preceded by a face to face meeting if the contact is to remain and long-term collaboration is to be established. To be effective, personal meetings should have a clear reason and should end with a plain contract. The contract must also include questions to be addressed at the next meeting, and meetings must be documented (Asproth & Nyström 2008).

5.4.1.3 IT complementary organisational resources

5.4.1.3.1 IT integration strategy

IT scholars, consultants and executives have universally indicated that companies should integrate IT with overall strategic planning efforts (Holland, Lockett & Blackman 1992) and therefore include IT integration strategy as a potential advantage producing complementarity (Powell & Dent-Micallef 1997). Clemons (1986) suggests that "the importance of selecting strategic opportunities, applications that are consistent with and support the firm's strategic objectives, requires real links between management information system and strategic planning. It also requires the ability to seek and to recognise these strategic opportunities." Furthermore, Rockart and Short (1989) report that not only does planning improve IT effectiveness but IT may also provide systems and information that can make planning more effective, creating a symbiotic IT planning relationship.

The findings of this research indicate that IT integration strategy has a direct positive impact on information sharing. It is argued that companies are now focusing on their strategic planning with the objective of developing long-term plans and changes to their organisation and in turn to improve their competitiveness. Strategic planning of IT should support the long-term objectives of SC information sharing in relation to improving both SC coordination and responsiveness (Byrd & Davidson 2003; Gunasekaran & Ngai 2004; Kim, Cavusgil &

Calantone 2006).The participants in the SC professionals' interviews cited attributes such as improving IT effectiveness, having a more responsive and responsible IT department, problem prevention and early detection of issues in using communication technologies, and creating an IT platform for their supply chain relationships as positive outcomes in this relation.

The results also show that IT integration strategy does not have a direct positive impact on SC coordination. Some of the barriers and limitations relating to this were identified in the SC professionals' interviews, especially by small sized companies. Participants referred to inadequate IT resources and infrastructure, the high cost of process change, and lower benefits by using IT in SC coordination activities as some of the main barriers in this regard. Furthermore, the results of these interviews showed a disparity in IT strategy between large and small firms in using IT in SC coordination. All the large firms had more ambitious plans for the future use of e-business technologies. In comparison, small sized firms stated that e-business was not even in their long-term horizon and vision.

Soliman and Youssef (2001) propose that an IT strategy should identify the aims, goals and context of the application; these choices should be aligned with other organisational and managerial choices, and should be integrated with the organisation's processes. For example, it is argued that IT will facilitate quick partnership formation by making available the right information and hence developing a virtual enterprise. Organisational restructuring may be necessary if a company decides to set up an enterprise resource planning (ERP) system (such as SAP and Oracle) with the objective of establishing an effective supply chain. There are also other potential implications which influence IT integration strategy such as investment in IT and re-engineering business process, technology position and employee relations, and workforce characteristics (Gunasekaran & Ngai 2004). The issue of societal implications and knowledge management should be given due consideration in developing strategic planning for IT in SC relationships. However, it is important to prioritise strategic dimensions that influence IT in SCM, taking into account the structure of individual organisations.

Furthermore, a 2007 OECD report shows that despite significant recent increases in Internet sales in many countries, total business-to-customer plus business-to-business Internet commerce only represented 2.2 percent of turnover in Australia, 1.3 percent in Canada and ranged from 0.01 to 17 percent in European countries (Walker & Harland 2008).

Gunasekaran and Ngai (2004) stated that the main reason for strategic ambiguity and time frame for investments in IT in B2B relationships is the lack of understanding of the business processes and justification for a suitable IT system for SCM. Kardaras and Karakostas (1999) recommend the use of fuzzy cognitive maps as an alternative approach to existing strategic information systems planning models. This is a helpful tool to facilitate creativity and synergy, to develop consensus and win commitment from those on whose actions the organisation's future defends. However, such tools should be user friendly and should have significant commitment from the management while implementing the recommendations made using the tools (Gunasekaran & Ngai 2004).

5.4.1.3.2 CEO commitment

CEO commitment (top management support) has been investigated in many areas of IT implementation and IT value research and has long been acknowledged as a main determinant of success. The importance that top management executives place on IT implementation and usage is reflected in many ways. For example, top management support and involvement could be considered by the level of funding for using IT in electronic integration with external parties. It may also encompass the facilitation of advanced technology transfer throughout the firm. In fact, several IT studies have indicated the significance of top management executive support in the implementation, use and success of IT between a firm and it supply chain partners (Byrd & Davidson 2003; Cash, McKenney & McFarlan 1992).

In the context of SC relationships, support from the senior (top) management is necessary to ensure benefits from IT, as it is strategically important. This is because a good understanding of the senior management regarding the various types of benefits to be gained encourages their commitment to IT. Companies in which senior management commitment to IT is strong generally allocate sufficient amount of financial and manpower resources to support electronic relationships (Bouchbout & Alimazighi 2008).

The results show that CEO commitment for IT implementation and usage has a direct positive impact on information sharing between a firm and its SC partners. Participants in the SC professionals' interviews pointed out many areas which depend on commitment of the

CEO. Such areas include importance of top management in providing IT resources (financial and manpower resources), support for establishing and transforming IT systems and applications, and setting IT direction for using IT technologies with SC partners.

However, in terms of the impact of top management support relating to SC coordination, the results do not support this hypothesis. It is important to note that the effectiveness of B2B communication technologies has a direct link to process integration between a firm and its SC partners. In other words, superior benefits from IT can be achieved when proper changes in business processes are introduced in combination with IT (Power & Singh 2007). Consequently, process changes may affect job responsibilities and even organisational structure and hence cannot be initiated without full support from senior management.

Moreover, it is difficult to gain IT benefits when SC partners are reluctant to use B2B communication technologies. Hence, management support is essential to convince SC partners to embrace IT and make essential changes in the inter-organisational workflow. It should also be mentioned that resistance to change may hold back the implementation of any new system. Within the company, organisational culture – especially at a senior level – should support cooperation with external entities. On the outside, effective use of IT needs the acceptance and cooperation of SC partners (Bouchbout & Alimazighi 2008; Gunasekaran & Ngai 2004).

The results of the SC professionals' interviews show that there is different attitude between top managers in large sized and small sized companies in relation to support and involvement in using IT technologies in their SC coordination activities. Although all participants from large sized companies mentioned their top managers' positive attitude and complete support in this relation, those from small sized companies believed that using IT in SC coordination activities is very time consuming, expensive, not relevant and the results are intangible, therefore their top management does not support these projects.

Harland et al. (2007) identify concern about additional investment requirements, short-termism and lack of vision of small sized company owner/managers and lack of understanding about potential benefits as some of the issues in this regard. Furthermore, some previous studies have highlighted that smaller businesses are often less aware of the full potential benefits of B2B e-commerce technologies. Beyond lack of awareness, small sized companies have been shown to exhibit a greater uncertainty about the benefits of IT adoption

than larger firms (Harland et al. 2007; Salmeron & Bueno 2006), which impacts on their motivation to invest in B2B communication technologies. Owner/managers of small sized companies tend to lack vision for the potential contribution of IT to attain competitive advantage (Cragg, King & Hussin 2002).

5.4.1.3.3 Customer orientation

The importance of customer orientation is noticeable in almost every industry, and its positive impact on business performance has been widely acknowledged (Jaworski & Kohli 1993). Customer orientation has been specified as an organisation's ability to adequately understand target buyers with the aim of continuously creating superior value for them (Wu, Mahajan & Balasubramanian 2003). Alternatively, it has been defined as the implication of a continuous, proactive disposition towards meeting customers' need. An important part of customer orientation is sensitivity to and foresight about the main forces that shape a market and an industry. A customer oriented firm is more ready to anticipate future customer requirements and have a long-term vision (Min, Mentzer & Ladd 2007). It is likely to have a more proactive approach towards the implication of new technologies, including those related to managing supply chain relationships.

As the results of this study indicate, customer orientation has a very important role (direct positive impact) in increasing information sharing between a firm and its supply chain partners by using IT technologies. In the SC professionals' interviews, all of the participants supported this positive relationship and noted different elements such as the requirement for providing on-time and accurate information for their customers (importance of visibility and transparency for customer), the requirement of having closer integration with customers, and better understanding of customer demand and the critical role of using customer feedback in business model and decision making processes.

The results of this study, however, do not support the direct positive impact of customer orientation in improving coordination activities between a firm and its SC partners by using IT technologies. Although most of the participants in the SC professionals' interviews indicated the importance of customer orientation and its positive impact on their SC coordination, two participants from small sized companies had opposing views. One mentioned that, because of their business characteristics such as amount of quantity order,

customer orientation does not have a direct positive impact on their type of relationships with their supply chain partners. The other participant believed that top management's role and their strategic decisions are more important than customer orientation in their type of relationship with supply chain partners.

In the literature it is emphasised that customer dominance and strategic focus are the two major factors that motivate companies to invest in IT. Customer relationship and customer pressure appear to play a critical role in IT utilisation (Harland et al. 2007; Min, Mentzer & Ladd 2007; Yasin, Czuchry Gonzales & Bayes 2006). It is argued that the lack of customer pressure to implement e-business in order to improve SC responsiveness has a significant impact on the motivation for using e-business with a firm's SC partners. According to Harland et al. (2007), face to face communication is still considered to be the best way of fulfilling customer requirements and wining their confidence; the attitude still is "It's who you know" that secures supplier relationships. For instance, companies – particularly smaller sized ones – preferred to purchase raw materials from recognised and trusted suppliers with whom loyalty took precedence over price. The differences in IT adoption within supply chains can be explained by lack of leadership to push electronic information integration upstream. Harland et al. (2007) emphasised that, among other concerns, disincentive from customers is a key driver for the lack of use of B2B communication technologies. This means that if the customer pushed, companies would adopt the e-business technologies.

5.4.2 SC channel capabilities: Information sharing, SC coordination and SC responsiveness

5.4.2.1 Impact of information sharing on SC coordination and SC responsiveness

Information sharing refers to the ability of a firm to share knowledge with channel partners to serve downstream customers effectively and efficiently. Such knowledge would encompass any changes in the business environment, for example, market and customer preferences. Timeliness, accuracy, adequacy, completeness,, and credibility of information are among the multiple dimensions of information sharing. In order for channel partners to utilise the information effectively and efficiently, it should be exchanged when required. It needs to come from a credible partner or source and in an adequate format, without missing any elements (Mohr & Sohi 1995).

Information sharing is usually achieved through the enhanced use of information technology or a closer integration among supply chain partners (Bagchi & Skjoett-Larsen 2003). However, it is argued that information sharing by itself does not offer much benefit. Alternatively, it contributes to channel capabilities such as coordination and responsiveness. Truman (2000) and Lewis (2001) reported that channel partners share more information in an attempt to enhance coordination. The purpose of efficient electronic linkage is to collect, interpret, filter, store and share data through effective information sharing within and across partners to improve efficiency in coordination activities. As an example of enhancing responsiveness through information sharing, Bechtel (cited in Catalan & Kotzab 2003) mentioned the requirement for precise information about real customer demand, especially for product with shorter life cycles. Thus it is important to create transparency in the logistics information system. With tightly coupled supply chain relations through sharing information in real time about consumer demand and component supplies, SC responsiveness can be enhanced.

The results reveal that information sharing has a direct positive impact on SC coordination and SC responsiveness. Truman (2000) stated that understanding the nature of the relationship between a buyer-supplier, its antecedents (information sharing) and its

consequences (firm performance) is very important to managers wishing to manage their company's information sharing capabilities to promote productive relationships with suppliers. Within a supply chain, the value of information sharing comes mostly from contributing to better relationships and from facilitating improved responsiveness and coordination. It improves relationships through the integration of SC partners' information systems, decision systems and business processes and therefore leads to superior performance (Hsu et al. 2008).

It has become critical for companies to effectively communicate with their SC partners to responsively align supply and demand. Traditionally, companies have operated in SC environments characterised by spare information (Sinclair, Siemieniuch, Cooper & Waddell 1995), excluded classes of information (e.g. information about substitute products), imperfect information (e.g. lack of timely information about discounts and promotions) or absence of compatible infrastructure such as compatible software and hardware for communication (Siemieniuch, Waddell & Sinclair 1999). These information asymmetries and lack of information sharing lead to greater operational inefficiencies, transaction risks and coordination costs (Clemons & Row 1992; Patnayakuni, Rai & Seth 2006).

As such, transaction risks can be decreased by sharing, monitoring and controlling information; for example usage of performance metrics, and production and delivery schedules (Kim & Umanath 1999). The information asymmetries can also be reduced by sharing sale data, inventory and production, along with planning and forecasting information. Furthermore, benefits of such coordination through information flow integration are expected to result in reduced operating costs and improved productivity, higher revenues, asset efficiency and improved customer responsiveness (Lee 2000; Tyndall, Partsch, Kamauff & Gopal 1998).

5.4.2.2 Impact of SC coordination on SC responsiveness

Dyer and Singh (1998) argue that a firm needs to develop effective coordination with its supply chain partners with the aim of maximising the potential for converting competitive advantage into profitability. Transactions are an essential element of supply chain relationships, and coordination activities for such transactions are critical for efficient channel

activities (Clemons, Reddi & Row 1993). Supply chain coordination in this research is considered as a channel capability, and conceptualised as the extent to which a company coordinates with channel partners efficiently (Shin 1999). Coordination with supply chain partners encompasses the coordination of materials, money, manpower and capital equipment from order taking to order follow-up (Sahin & Robinson 2002). In other words, inter-firm coordination ranges from the collection of product and price-related information such as inventory level, new product launch and pricing to order follow-up activities including order confirmation and shipment tracking.

Li and Liu (2006) note that supply chain members can benefit from a coordination of quantity discount policies. Vendor management inventory is the other recent development, an arrangement under which suppliers takes responsibility for maintaining stock levels at their customers' sites, so improving their customers' reordering decisions (Holweg 2005). Lee (2000) by using the computer industry as an example, described the alignment of value adding task in some supply chains. Collins et al. (1997) explain how similar shifts in the automotive value chain can contribute to enhanced supply chain responsiveness and general performance by leveraging core competencies and realigning complexity.

The results show that SC coordination has a direct positive impact on SC responsiveness. Supply chain responsiveness in this research is deemed to be the extent to which the firm reacts cooperatively to changes in the environment and market quickly and effectively. It elicits the dynamic nature of a company's channel capabilities which enable it to develop and renew its specific competencies and to better react to shifts in the environment (Kim & Cavusgil 2009; Teece, Pisano & Shuen 1997). According to Chopra and Meindl (2001), the aim of improving SC relationships had its roots in finding a balance between responsiveness and efficiency by implementing better solutions compared to competitors' strategies. Overall, SCM entails activities such as purchase of raw material, production planning, production and transportation in order to deliver added value to the final customer. Some of the main SCM functions encompass sourcing and procurement, demand forecasting, inventory and warehouse management, and distribution logistics. A company that performs these functions effectively can deliver products quickly with lower costs than its competitors.

5.4.3 Impact of SC channel capabilities on firm performance (market and financial performances)

5.4.3.1 Firm performance

Firm performance refers to how well an organisation achieves its market orientation as well as its financial goals. Li et al. (2006) noted that the short-term objectives of SCM are mainly to enhance productivity and reduce inventory and cycle time, and the long-term objectives are to enhance market share and profits for all members of the supply chain.

The results indicate that information sharing and SC responsiveness have a direct positive impact on a firm's financial and market performances. The positive impact of information sharing on financial and market performance was highlighted by the participants in the SC professionals' interviews, including improving product quality, daily order quantity, lead time, delivery schedule, production schedule and order fulfilment rate. The benefits also lead to a reduction in demand uncertainty, reducing production waste, having a better promotional plan and discount policy, and competitive pricing strategy. Some of the benefits of SC responsiveness on firm performance emphasised by the participants also include: higher product availability, product variety and customisation, improving delivery time, better response to customer enquiries, distribution lead time and product development.

In terms of the impact of SC coordination on financial and market performance, the results of this study do not support the relationships between SC coordination on financial and market performance. This means that IT capability only indirectly through information sharing, is not able to enhance a firm's performance through SC coordination. IT resources not only take time, financial resources and require organisational readiness (e-business readiness) to acquire and build, but also entails associated difficulties in order to improve SC coordination between a firm and its SC partners and consequently enhance firm performance. One of the main issues for using IT in SC coordination is related to costs associated with changing of existing processes to electronically enabled processes. In fact, the strong association between application of B2B communication technologies and structural change could be interpreted as an indication of a reduction in information search and related costs by using these

technologies, leading to an expectation of modified coordination costs. However, this should not necessarily be interpreted as a reduction in all costs rather a re-allocation of costs. Some of these costs are changing because of the technologies creating a requirement for improvements in data quality and connection of legacy systems (Davenport & Short 2003; Power & Singh 2007). In this situation, the possibility of decreasing the cost of information access creates conditions in which investment is needed in managing data and connecting systems. Coordination costs would not be expected to decrease until this has been achieved at a requisite level. Other costs are in relation to organisational structures and processes. Overall, reduced information related costs involve primary issues concerning the interaction of functions and how tasks are performed to be considered in order to achieve better coordination. Therefore, the application of IT could reduce information search and related costs, but whether this in actual fact leads to reduced coordination costs is difficult to establish, as the imperative for change is strong. In the long term, as new structures (data, system, process and organisational) come into effect, it can be expected that coordination costs will be decreased (Davenport & Short 2003; Power & Singh 2007).

Finally, the findings revealed that, despite the critical roles of SC channel capabilities in recognising the value of IT on firm performance, achieving such capabilities is not an easy task. SC channel capabilities, as higher order organisational capabilities, represent a company's abilities to effectively combine resources using information based organisational processes to serve customers (Amit & Schoemaker 1993). A higher level of knowledge integration from multiple sources and SC partners throughout the supply chain is needed to perform the tasks effectively and efficiently (Grant 1996). The findings suggest that electronic integration along with human IT resources and IT complementary organisational resources are able to facilitate the development of supply chain capabilities through information sharing. By deploying appropriate communication technologies for supply chain relationships, especially before they are diffused widely, firms are expected to achieve higher efficiency than their competitors in channel activities with SC partners (Boone & Ganeshan 2001). The adoption and utilisation of B2B communication technologies for electronic integration can improve information sharing directly and coordination between SC partners indirectly. Due to the interdependency and connection enabled by IT, the once isolated decision making process from upstream suppliers to the downstream customers is becoming more intertwined (Bowersox, Closs & Stank 1999; Wu et al. 2006). Indeed, according to

Vakharia (2002), the aim of information sharing is to ‘‘facilitate integrated and/or coordinated decision making in supply chain’’. In addition, sharing information across the supply chains can help firms forecast market demands better, reduce inventory costs and be more responsive to customer orders (Lin, Huang & Lin 2002).

5.5 Research contributions

Several research contributions drawn from the results of this study are included in the theoretical and practical contributions.

5.5.1 Theoretical contributions

The results serve to underline an important issue relevant to the application and development of theory in a supply chain context.

1. Due to the complexity of the concept of SCM, researchers should be cautious when applying single theories to clarify multiple interrelationships. This mono-theoretic approach may be more beneficial to studies focusing on dyadic perspectives. Consequently, when trying to develop, test or verify theory outside of this narrower context, a multiple theory approach is perhaps more useful to explain the complex interplay of factors more likely to be found in the real world (Power & Singh 2007). Therefore, this research integrates two streams of theories and creates a conceptual framework that identifies the detailed dimensions of IT capabilities, SC channel capabilities and firm performance. The research conceptual model is rooted in the emergent stream of resource based view (RBV) and complemented by transaction cost economics (TCE). This framework provides a foundation for future research. In the future, new constructs may be added to provide more in-depth understanding of the business value of IT in supply chain management.

2. This study contributes to the growing body of literature linking IT and the resource based view and presents a framework for understanding how IT may be properly viewed as an organisational capability. The research provides a threefold identification of IT resources in terms of electronic integration, human IT resources and IT complementary organisational

resources (IT enabled intangibles resources), and develops this notion of IT as an organisational capability created by the synergistic combination of IT resources and other IT complementary organisational resources. The implications of the results for transaction cost economics theory are also notable in this study. The findings that application of B2B communication technologies are associated with collaboration in supply chain relationships through investment in integration systems and dedication of resources supports the appropriateness of the inter-organisational governance structure in this context (Williamson 1991). Trust was not a dimension measured directly in this study, but is a rational precondition for effective SC channel capabilities (Power & Singh 2007).

3. Results from this research also contribute to the literature pertaining to the business value of IT. The fact that a particular firm invests heavily on IT does not necessarily mean that it has an effective IT capability in B2B relationships. Given the complexity in creating a firm-wide IT capability, in any sample of IT spenders or IT users, only a small subset of the sample is likely to have the right IT resources in place for achieving competitive advantage. Other firms are more likely to have incurred the expenses of IT without relative parity in IT capability (Bharadwaj & Menon 2000).

Finally, the study provides an instrument that is valid and reliable for the context of this research. The measurement instruments include: 1) electronic integration, 2) Human IT resources, 3) IT complementary organisational resources, 4) supply chain channel capabilities and 5) firm performance. All the scales have been tested using rigorous statistical methodologies including pre-test, confirmatory factor analysis, reliability, and the validation of second order constructs. All the scales are shown to meet the requirements for reliability and validity and thus, can be used in future research. Such valid and reliable scales have been otherwise lacking in the literature, and their development will greatly stimulate and facilitate theory development in this field.

5.5.2 Practical contributions and managerial implications

The results of this study have several important implications for practitioners. Business managers, supply chain/logistics managers as well as IT managers or IT strategists can potentially benefit from this research.

1. As today's competition is changing from competing between companies to competing between supply chains, more companies are using information technologies in the hope of improving their SC relationships and firm's performance. However, there are doubts about the potential benefits from information technology utilisation. The results of this study assure the business managers that information technology utilisation is an effective way of competing, and electronic integration implementation does have a strong impact on competitive advantage and firm performance.

2. By establishing the link between IT capability and superior firm performance, this study serves to inform business managers and practitioners that firms should go beyond just investing in IT. They should identify ways and means of creating firm-wide IT capabilities. There is the danger of falling into what Sinkovics and Yamin (2006) call the "virtuality trap". Companies need to utilise different levels of electronic integration based on data consistency and system integration to gain desired levels of control, coordination and learning among their supply channel partners (Jean, Sinkovics & Kim 2008).

3. Information sharing using electronic linkages, if properly deployed, offers the capability of providing significant benefits to supply chain partners on both sides of the relationship. This means that a firm cannot only deliver cost savings to its supply chain partners, but also improve the service it provides during reducing its own costs of operation. When a firm can decrease its trading partners' transaction costs whilst simultaneously reducing its own, the entire supply channel performs more effectively (Kim & Umanath 2005). The important point in this complex set of relationships is the degree of electronic information transfer between the participating firms. This study illustrates why managers should invest time and effort in assessing current and future information sharing with their supply cain partners and align their IT capabilities accordingly.

Additionally, information sharing seems to be a cornerstone for other channel capabilities and firm performance. The results indicate that its influence on SC coordination, SC responsiveness and firm performance is significant. The results also indicate that effective SC coordination improves SC responsiveness and firm performance directly. Hence, managers need to realise that the different dimensions of supply chain capabilities are interrelated. It is also important for managers to understand the different roles of key channel activities in improving firm performance (Wu et al. 2006). Moreover, a firm's supply chain capabilities are likely to contribute more to its performance when stemming from well-balanced supply chain activities rather than from fragmented and imbalanced activities.

4. New opportunities for business integration between a firm and its suppliers have emanated owing to electronic linkages. The instrument used in this study provides practitioners with additional capabilities in the assessment of electronic integration. It enables them to isolate and examine decision and operation integration, information sharing and/or monitoring and control aspects of information transfer/flow infrastructure of the firm and its supply chain partners and to strengthen the weaker links (Kim & Umanath 2005).

5. It is crucial for firms to not only pay attention to IT infrastructures, but also to complement these with other organisational resources (human IT resources and complementary organisational resources), in order to establish a relational embeddedness between supply chain partners and standardised business processes in the supply chain. All IT capabilities in companies need to be managed effectively and maintained through core IT managerial skills and techniques. Companies should try to develop and keep their own core IT skills and techniques instead of outsourcing to third parties. Otherwise, there is a danger of replication from competitors and loss of competitive position (Jean, Sinkovics & Kim 2008).

Furthermore, this study particularly stresses the importance of developing strong human IT resources. While participants in this study acknowledge the strategic value of IT, some of them also tend to view IT activities as commodity services, and target these activities for cost cutting. The findings reveal that strong IT capabilities enable companies to effectively leverage IT in pursuit of firm strategies, suggesting that such a cost-focused approach to managing IT might be dysfunctional. Managers who understand the strategic value of IT capabilities must proactively educate senior management on the value of IT activities and

seek the necessary funding to renew and improve these capabilities. Therefore, managers have to develop effective resource acquisition strategies in order to maintain a valuable asset base comprising personnel, technology and relationships to support IT initiatives. Careful planning in the acquisition of technology platforms is required to ensure that the IT infrastructure remains state-of-the-art (Ravichandran & Lertwongsatien 2005).

6. The results indicate that IT capabilities have an indirect impact on supply chain coordination. This means that top managers should not assume that all investments are equally effective. The same level of investment does not guarantee the same result. In the complex environment of the supply chain, the successful implementation of IT enabled coordination of projects is essentially a management problem which requires a thorough understanding of the business conditions for all companies involved. Companies should have the processes and procedures in place to capture the full potential of IT implementation. The different business contexts of the individual supply chain partners have to be aligned to the supply chain (Li, Yang, Sun & Sohal 2009). Members in the supply chain should transform their coordination patterns and build an open and uniform framework to support IT implementation throughout the supply chain.

Additionally, top management should investigate technology investment strategies because investing in the wrong technology can become a competitive disadvantage. Their investment in technology should be geared towards external integration which in turn will assist in improving supply chain relationships. In fact, many companies still tend to consider IT utilisation at the infrastructural and operational level, not at the strategic level (refer to IT integration strategy). Strategic information technologies should be given top priority as they provide building blocks for the success of supply chain channel capabilities.

7. The results highlight the critical role of supply chain partners in facilitating supply chain integration. Effective relationships with suppliers and customers will directly lead to a higher level of supply chain channel capabilities which in turn will lead to a higher level of business performance for firms. This is particularly relevant as firms start to implement e-business technologies. Firms should invest in initiatives such as training and on-site assistance with their supply chain partners, which together with trust and good selection of supply chain partners will offer them a better chance to succeed in on-demand e-business implementation.

However, it important to note that the infrastructures that e-business enabled companies build around relationships could affect traditional firms. Relationships can create barriers to competition as suppliers and customers depend on those with whom they work on a continual basis. This may make it crucial that traditional businesses better manage their relationships so as not to lose suppliers or customers. This will make it easier for them to cope with uncertainty, changing markets and visibility to greater amounts of information when they occur in the traditional environment (Golicic, Davis, McCarthy & Mentzer 2002).

8. This research has implications for practitioners who seek to establish electronic integration related projects through Internet technologies. While providing the means by which companies can integrate systems and processes cost-effectively, it is clear that implementation will increase the requirement for both structural change and closer cooperation with supply chain partners (Power & Singh 2007). This would involve the capability of organisations to cope with organisational restructuring, basic data and systems management and process redesign, and to develop strong SC partner relationships (Gunasekaran & Ngai 2004; Power & Singh 2007).

Finally, companies may have to invest in change management policies and procedures aimed at more effective usage of B2B communication technologies. This type of structural change is not easy or an option as a first choice for most practitioners. The disruption, associated risks and costs of change together result in a tendency to remain unchanged (Davenport & Short 2003; Power & Singh 2007). The B2B communication technologies that enable extensive sharing and integration of data between supply chain partners creates a situation that requires much organisational change to provide the benefits of such integration (Power & Singh 2007).

5.6 Limitations of the study and future research directions

Several limitations of this study may be addressed in future research, as follows.

1. The data for the study consisted of responses from single respondents in an organisation, which may be a cause of possible response bias. Although the researcher did not find any significant evidence for common method bias, it is possible that other types of bias including social desirability bias could have influenced the results of the study. It is also conceivable that the respondents' choice of particular SC partners on which to base their answers is a source of bias. Respondents may have chosen only those SC partners with whom they maintained good relations and neglected to report their experiences in less successful relationships. Future studies should compensate for this potential bias by investigating a large number of specific relationships for each respondent. In addition, because of the perceptual nature of the data, the reported results may generate some measurement inaccuracy. A dataset with multiple informants could enhance the validity of the findings. Future research should consider research designs that allow data collection from multiple respondents within an organisation. Increasingly, IT capabilities are dispersed throughout the firm. Thus, research that involves respondents from multiple functional areas might allow for a richer measurement of the constructs used in this study. Furthermore, it would be interesting to explore the effect of IT on supply chain relationships from a dyadic perspective or perhaps an extended supply chain. Are other supply chain members' experiences the same as or different from those evaluated?

2. This study uses cross-sectional data and is mainly static in nature. Since the data represents a snapshot in time, the imputation of cause-effect relationships between the constructs in the model must be made with caution. Although the researcher established the associations between the causing and the caused constructs statistically, the sequential relationships between the constructs were argued by the researcher based on theory. A more profound insight into the IT productivity paradox would arise from a longitudinal analysis of the relationship of electronically enabled supply chain and performance using a mixed methods approach. For example, this study could be analysed using a longitudinal approach, such as the evolution of e-business usage and value in a dynamic context. Studies adopting a more longitudinal focus are also essential to understanding why some firms are better at converting

their IT investments and implementation into superior IT capability. An investigation to identify the most important IT resources and skills is essentially an investigation to understand the nature of superior IT performance. Such studies will yield insights into the exact nature of IT resources, how they develop and evolve in a firm, and how they can be leveraged for superior profit performance. The findings of this research show only the nature of relationships between the different constructs. A more complete test of the research model would require longitudinal in-depth case studies and comparison of survey results over an extended period of time.

3. The constructs used in the research model are latent variables that are not directly observable. Therefore, it is necessary to measure manifestations of constructs using indicators. Since a large number of indicators could reflect a construct, a sampling approach was adopted where indicators well aligned with the research conceptual definitions were included in the measurement scales for the constructs. Given the constraints of survey length, it is possible that the researcher may not have sampled all items from a construct's domain. Recognising this limitation, the researcher recommends that future research refine both the conceptual definitions and the measurement scales for the constructs. Such incremental modification is in the tradition of cumulative research that could build on and extend the findings reported here. For instance, this study used only three measurement items for each SC channel capability: information sharing, SC coordination and SC responsiveness. Future studies may employ additional items to assess each SC channel capability adequately. Furthermore, this study used perceived measures of market and financial performance by managers as opposed to hard measures such as actual return on investment.

4. This research has been conducted in Australia, with the quantitative study restricted to the membership of the GS1 organisation. The research sample is largely representative of the FMCG industries. Whether results would be consistent in other countries and industries would need to be verified through further research. In addition, as nearly 70 percent of the organisations in the research sample have employee number less than 100 employees, the results may be overly representative of relatively small and medium sized business units. This needs to be addressed in future research. New mailing lists and research methods may be applied to improve the limitations. It would be particularly useful to conduct a multi-country and/or multi-industry comparison to test the influence of moderating factors such as national

culture and industry characteristics. This would involve examining cross-cultural variances which can occur among companies in different countries to identify, for instance, the similarities and differences with regard to adoption profiles, the influence of regional contexts, and the extent to which a company heterogeneity varies between countries (if at all).

5. This study has demonstrated a solid theoretical basis of the resource based view framework in conjunction with transaction cost economics theory. It has shown the usefulness of this framework for identifying factors that affect B2B communication technologies usage and value. In particular, electronic integration is shown as an important link to business value. This framework could be used by other researchers for studying specific technologies use as well. This study focused on the impact of overarching ITs, and not on any specific IT technologies or applications. Furthermore, previous studies have suggested many different classifications of ITs (Kendall 1997). But regardless of classification, it can be assumed that some ITs have a more direct and significant impact on SC channel capabilities and firm performance for some kinds of supply chains than others. Given the high cost of IT implementation, it may be important for future studies to consider the impact of different types of ITs on different types of supply chains. A model for matching ITs with supply chain characteristics is required, so that managers can more easily find the best form of IT implementation. Future quantitative and/or qualitative research can focus on determining which applications or IT technologies are most suitable for small or large sized companies' business goals and dimensions of heterogeneity. In addition, future studies can identify and investigate new solutions which address the difficulties which companies face using IT applications. For instance, these might include novel solutions to address security concerns or the difficulties faced in integrating software from different providers.

6. Another natural extension of this study would be to investigate factors that facilitate electronic information transfer between the participating firms further than a single supply channel, that is, an extension from the SC considered in this study to the entire supply chain. Among others, organisational trust and power may be of special interest in the e-business economy because supply chain partners naturally experience uncertainty due to the novelty of the electronic channel (Burgess & Singh 2006; Jarvenpaa & Todd 1996). Many scholars (Kim, Umanath & Kim 2006; Miranda & Saunders 2003) state that a continuing cooperative relationship with other companies is based more on trust and equity than on monitoring and

control capabilities. The various types of intervention strategies which can be used within the network of trust and IT support relationships should be investigated. Such investigations could use both qualitative and quantitative research methodologies for performing cost-benefit analyses of the intended intervention strategies. Future research could also investigate which supply chain members are most suited to use particular intervention strategies based on company trust preferences.

7. In this study, the importance of IT (integration) strategy formulation processes combined with the capability of the organisation to implement and manage change were found to have a positive influence on technology related outcomes. It would be useful as a follow-up research to examine some other specific theories in the strategic management and inter-organisational relationships literature. In particular, the resource dependency and agency theories could be incorporated into a similar model to test for the influence these theoretical perspectives could have on determining information technology choice, implementation and potential outcomes.

Finally, in many ways, the electronically enabled supply chain phenomenon has only begun. There is much yet to happen and much to be learned. It is expected that this study will catalyse further research in the area.

References

ABS 2002, *Small Business in Australia 2001,* viewed 28 May 2010 http://www.abs.gov.au/ausstats/abs@.nsf/productsbytopic/97452F3932F44031CA256C5B00027F19?OpenDocument.

Achrol, RS & Gundlach, GT 1999, 'Legal and social safeguards against opportunism in exchange', *Journal of Retailing*, vol. 75, no. 1, pp. 107-124.

Ahituv, N 1989, 'Assessing the value of information: Problems and approaches', Proceedings of the tenth international conference on information systems, Boston, MA.

Aitken, J, Christopher, M & Towill, D 2002, 'Understanding, implementing and exploiting agility and leanness', *International Journal of Logistics Research and Applications*, vol. 5, no. 1, pp. 59-74.

Alter, SL 1995, *Information systems: a management perspective,* Benjamin-Cummings Publishing Co., Redwood City, CA.

Amit, R & Schoemaker, PJH 1993, 'Strategic assets and organizational rent', *Strategic Management Journal*, vol. 14, no. 1, pp. 33-46.

Amit, R & Zott, C 2001, 'Value creation in e-business', *Strategic Management Journal*, vol. 22, no. 6-7, pp. 493-520.

Anderson, D. L., F. E. Britt, Favre, D. J. 1997, 'The seven principles of supply chain management' *Supply Chain Management Review,* vol. 1, no. 1, pp 1-12.

Andersen, TJ & Segars, AH 2001, 'The impact of IT on decision structure and firm performance: evidence from the textile and apparel industry', *Information & Management*, vol. 39, no. 2, pp. 85-100.

Anderson, AB, Basilevsky, A & Hum, DPJ 1983, Measurement: theory and techniques*, The handbook of survey research,* Academic Press, NY.

Angeles, R 2000, 'Revisiting the role of Internet-EDI in the current electronic commerce scene', *Logistics Information Management*, vol. 13, no. 1/2, pp. 45-57.

Angerhofer, BJ & Angelides, MC 2006, 'A model and a performance measurement system for collaborative supply chains', *Decision Support Systems*, vol. 42, no. 1, pp. 283-301.

Angulo, A, Nachtmann, H & Waller, MA 2004, 'Supply chain information sharing in a vendor managed inventory partnership', *Journal of Business Logistics*, vol. 25, no. 1, pp. 101-120.

Archer, N & Yuan, Y 2000, 'Managing business-to-business relationships throughout the e-commerce procurement life cycle', *Internet Research: Electronic Networking Applications and Policy*, vol. 10, no. 5, pp. 385-395.

Asif, Z & Mandviwalla, M 2005, 'Integrating the supply chain with RFID: A technical and business analysis', *Communications of the Association for Information Systems*, vol. 15, no. 24, pp. 393-426.

Asproth, V & Nyström, CA 2008, 'Communication and information exchange among SMEs and their local environment', *Organisational Transformation and Social Change*, vol. 5, no. 2, pp. 175-189.

Auramo, J, Aminoff, A & Punakivi, M 2002, 'Research agenda for e-business logistics based on professional opinions', *International journal of Physical Distribution and Logistics Management*, vol. 32, no. 7, pp. 513-531.

Auramo, J, Kauremaa, J & Tanskanen, K 2005, 'Benefit of IT in supply chain management: an explorative study of progressive companies', *International journal of Physical Distribution and Logistics Management*, vol. 35, no. 2, pp. 82-100.

Azevedo, S & Ferreira, J 2007, '*The Linkage between LIS and RBV for sustained competitive advantage: an integrated conceptual model*', viewed 12 November 2010, http://mpra.ub.uni-muenchen.de/5648/1/Azevedo_file_29_10_007.pdf.

Azzalini, A 2005, 'The skew-normal distribution and related multivariate families', *Scandinavian Journal of Statistics*, vol. 32, no. 2, pp. 159-188.

Azzone, G, Masella, C & Bertele, U 1991, 'Design of performance measures for time-based companies', *International Journal of Operations & Production Management*, vol. 11, no. 3, pp. 77-85.

Bacharach, SB 1989, 'Organizational theories: Some criteria for evaluation', *Academy of Management Review*, vol. 14, no. 4, pp. 496-515.

Baganha, MP & Cohen, MA 1998, 'The stabilizing effect of inventory in supply chains', *Operations Research*, vol. 46, no. 3, pp. 72-83.

Bagchi, PK & Skjoett-Larsen, T 2003, 'Integration of information technology and organizations in a supply chain', *International Journal of Logistics Management*, vol. 14, no. 1, pp. 89-108.

Bagozzi, RP & Yi, Y 1988, 'On the evaluation of structural equation models', *Journal of the Academy of Marketing Science*, vol. 16, no. 1, pp. 74-94.

Baines, S & Wheelock, J 1998, 'Reinventing traditional solutions: job creation, gender and the micro-business household', *Work, Employment & Society*, vol. 12, no. 4, pp. 579-601.

Bakos, JY 1997, 'Reducing buyer search costs: implications for electronic marketplaces', *Management Science*, vol. 43, no. 12, pp. 1676-1692.

Bakos, JY & Treacy, ME 1986, 'Information technology and corporate strategy: a research perspective', *MIS Quarterly*, vol. 10, no. 2, pp. 107-119.

Bakos, YJ 1991, 'information links and electronic marketplace: the role of interorganizational information systems in vertical markets', *Journal of Management Information Systems*, vol. 8, no. 2, pp. 31-52.

Balakrishnan, S & Koza, M 1993, 'Information asymmetry, adverse selection, and joint ventures: theory and evidence', *Journal of Economic Behavior and Organization*, vol. 20, no.1, pp. 99-117.

Balsmeier, P & Voisin, W 1996, 'Supply chain management: a time-based strategy', *Industrial Management*, vol. 38, no.5, pp. 24-27.

Barclay, I, Poolton, J & Dann, Z 1996, 'Improving competitive responsiveness via the virtual environment' International Conference on Engineering and Technology Management -IEEE, pp.52-62.

Barney, JB 1986, 'Strategic factor markets: expectations, luck, and business strategy', *Management Science*, vol. 32, no. 10, pp. 1231-1241.

Barney, JB 1991, 'Firm resources and sustainable competitive advantage', *Journal of Management*, vol. 17, no. 1, pp. 99-120.

Barratt, M 2004, 'Understanding the meaning of collaboration in the supply chain', *Supply Chain Management: An International Journal*, vol. 9, no. 1, pp. 30-42.

Bartlett, JE, Kotrlik, JW & Higgins, CC 2001, 'Organizational research: Determining appropriate sample size in survey research', *Information Technology Learning and Performance Journal*, vol. 19, no. 1, pp. 43-50.

Bassok, Y & Anupindi, R 1997, 'Analysis of supply contracts with total minimum commitment', *IIE Transactions*, vol. 29, no. 5, pp. 373-381.

Beamon, BM 1999, 'Measuring supply chain performance', *International journal of Operations and Production Management*, vol. 19, no. 3, pp. 275-292.

Bendavid, B & Bourgault, M 2005, 'Positioning project management for RFID implementation in a multi-firm, multi-project context' Proceedings of the International Association of Management of Technology (IAMOT'05), Vienna, Austria.
Bendavid, Y, Lefebvre, E, Lefebvre, LA & Wamba, SF 2007, 'B-to-B E-commerce: assessing the impacts of RFID technology in a five layer supply chain' Proceedings of 40th Annual Hawaii International Conference on System Sciences, IEEE.
Benjamin, RI, De Long, DW & Scott Morton, MS 1990, 'Electronic data interchange: how much competitive advantage?', *Long Range Planning*, vol. 23, no. 1, pp. 29-40.
Benjamin, RI & Levinson, E 1993, 'A framework for managing IT-enabled change', *Sloan Management Review*, vol. 34, no. 4, pp. 23-33.
Benjamin, RI, Rockart, JF, Morton, S & Wyman, J 1984, 'Information technology: a strategic opportunity', *Sloan Management Review*, vol. 25, no. 3, pp. 3-10.
Bensaou, M 1997, 'Interorganizational cooperation: the role of information technology an empirical comparison of US and Japanese supplier relations', *Information Systems Research*, vol. 8, no. 2, pp. 107-124.
Bensaou, M & Venkatraman, N 1995, 'Configurations of interorganizational relationships: a comparison between US and Japanese automakers', *Management Science*, vol. 41, no. 9, pp. 1471-1492.
Bergen, M, Dutta, S & Walker Jr, OC 1992, 'Agency relationships in marketing: a review of the implications and applications of agency and related theories', *The Journal of Marketing*, vol. 56, no. 3, pp. 1-24.
Bergen, M & John, G 1997, 'Understanding cooperative advertising participation rates in conventional channels', *Journal of Marketing Research*, vol. 34, no. 3, pp. 357-369.
Bernardes, ES & Hanna, MD 2009, 'A theoretical review of flexibility, agility and responsiveness in the operations management literature', *International journal of Operations and Production Management*, vol. 29, no. 1, pp. 30-53.
Berry, WL & Cooper, MC 1999, 'Manufacturing flexibility: methods for measuring the impact of product variety on performance in process industries', *Journal of Operations Management*, vol. 17, no. 2, pp. 163-178.
Bharadwaj, AS 2000, 'A resource-based perspective on information technology capability and firm performance: an empirical study', *MIS Quarterly*, vol. 24, no. 1, pp. 169-196.
Bharadwaj, S & Menon, A 2000, 'Making innovation happen in organizations: individual creativity mechanisms, organizational creativity mechanisms or both?', *Journal of Product Innovation Management*, vol. 17, no. 6, pp. 424-434.
Bharadwaj, AS, Bharadwaj, SG & Konsynski, BR 1999, 'Information technology effects on firm performance as measured by Tobin's q', *Management Science*, vol. 45, no. 7, pp. 1008-1024.
Bhatt, GD 2000, 'An empirical examination of the effects of information systems integration on business process improvement', *International journal of Operations and Production Management*, vol. 20, no. 11/12, pp. 1331-1359.
Biehl, M 2005, 'Selecting internal and external supply chain functionality: The case of ERP systems versus electronic marketplaces', *Journal of Enterprise Information Management*, vol. 18, no. 4, pp. 441-457.
Birtwistle, G, Siddiqui, N & Fiorito, SS 2003, 'Quick response: perceptions of UK fashion retailers', *International Journal of Retail & Distribution Management*, vol. 31, no. 2, pp. 118-128.

Blankley, A 2008, 'A conceptual model for evaluating the financial impact of supply chain management technology investments', *International Journal of Logistics Management*, vol. 19, no. 2, pp. 155-182.
Blunch, NJ 2008, *Introduction to Structural Equation Modelling Using SPSS and AMOS,* Sage, London.
Bollen, KA 1989, *'Structural equations with latent variables'*, John Wiley and Sons, NY.
Bollen, KA & Stine, RA 1992, 'Bootstrapping goodness-of-fit measures in structural equation models', *Sociological Methods & Research*, vol. 21, no. 2, pp. 205-229.
Bond, B, Genovese, Y, Miklovic, D, Wood, N, Zrimsek, B & Rayner, N 2000, 'ERP is Dead–Long live ERP 2', *Gartner Group,* NY.
Boone, T & Ganeshan, R 2001, 'The effect of information technology on learning in professional service organizations', *Journal of Operations Management*, vol. 19, no. 4, pp. 485-495.
Bouchbout, K & Alimazighi, Z 2008, 'A Framework for Identifying the Critical Factors Affecting the Decision to Adopt and Use Inter-Organizational Information Systems', *Engineering and Technology,* World Academy of Science, vol. 43, pp.338-345.
Bourland, KE, Powell, SG & Pyke, DF 1996, 'Exploiting timely demand information to reduce inventories', *European Journal of Operational Research*, vol. 92, no. 2, pp. 239-253.
Bowersox, DJ, Calantone, RJ, Clinton, SR, Closs, DJ, Cooper, MB, Droge, CL, Fawcett, SE, Frankel, R, Frayer, DJ & Morash, EA 1995, *World Class Logistics: the challenge of managing continuous change*, Council of Logistics Management, Oak Brook, IL.
Bowersox, DJ & Closs, DJ 1996, *Logistical management: the integrated supply chain process,* McGraw-Hill, NY.
Bowersox, DJ, Closs, DJ & Stank, TP 1999, *21st century logistics: making supply chain integration a reality,* Council of Logistics Management, Oak Brook, IL.
Bowersox, DJ, Closs, DJ & Stank, TP 2000, 'Ten mega-trends that will revolutionize supply chain logistics', *Journal of Business Logistics*, vol. 21, no. 2, pp. 1-16.
Bowersox, DJ & Daugherty, PJ 1995, 'Logistics paradigms: the impact of information technology', *Journal of Business Logistics*, vol. 16, no.1, pp. 65-80.
Brancheau, JC & Wetherbe, JC 1987, 'Key issues in information systems management', *MIS Quarterly*, vol. 11, no. 1, pp. 23-45.
Breath, CM & Ives, B 1986, 'Competitive information systems in support of pricing', *MIS Quarterly*, vol. 10, no. 1, pp. 85-96.
Breitenbach, CS & Van Doren, DC 1998, 'Value-added marketing in the digital domain: enhancing the utility of the Internet', *Journal of Consumer Marketing*, vol. 15, no. 6, pp. 558-575.
Brown, JS & Duguid, P 2002, *The social life of information,* Harvard Business school press, Boston.
Brown, TA & Bukovinsky, DM 2001, 'ECR and grocery retailing: an exploratory financial statement analysis', *Journal of Business Logistics*, vol. 22, no. 2, pp. 77-90.
Browne, MW & Cudeck, R 1993, *Alternative ways of assessing model fit,* Sage Publications, Newbury Park, NY.
Bruce, M, Daly, L & Towers, N 2004, 'Lean or agile: a solution for supply chain management in the textiles and clothing industry?', *International Journal of Operations and Production Management*, vol. 24, no. 2, pp. 151-170.
Brynjolfsson, E 1993, 'The productivity paradox of information technology', *Communications of the ACM,* vol. 36, no. 12, pp. 66-77.

Brynjolfsson, E & Hitt, L 1994, 'The three faces of IT value: Theory and evidence', Proceedings of the 15th International Conference on Information Systems, Vancouver, PP. 47-64.
Brynjolfsson, E & Hitt, LM 2000, 'Beyond computation: Information technology, organizational transformation and business performance', *The Journal of Economic Perspectives*, vol. 14, no. 4, pp. 23-48.
Brynjolfsson, E & Hitt, LM 2003, 'Computing productivity: Firm-level evidence', *Review of Economics and Statistics*, vol. 85, no. 4, pp. 793-808.
Bunge, M 1967, *Scientific research: The search for system,* Springer-Verlag, NY.
Burbidge, JL 1961, 'The new approach to production', *The Production Engineer*, vol. 40, no. 12, pp. 769-784.
Burgess, K & Singh, PJ 2006, 'A proposed integrated framework for analysing supply chains', *Supply Chain Management: An International Journal*, vol. 11, no. 4, pp. 337-344.
Burgess, K, Singh, PJ & Koroglu, R 2006, 'Supply chain management: a structured literature review and implications for future research', *International journal of Operations and Production Management*, vol. 26, no. 7, pp. 703-729.
Byrd, TA & Davidson, NW 2003, 'Examining possible antecedents of IT impact on the supply chain and its effect on firm performance', *Information & Management*, vol. 41, no. 2, pp. 243-255.
Byrd, TA & Marshall, TE 1997, 'Relating information technology investment to organizational performance: A causal model analysis', *Omega*, vol. 25, no. 1, pp. 43-56.
Byrd, TA & Turner, DE 2000, 'Measuring the flexibility of information technology infrastructure: Exploratory analysis of a construct', *Journal of Management Information Systems*, vol. 17, no. 1, pp. 167-208.
Byrd, TA & Turner, DE 2001, 'An exploratory analysis of the value of the skills of IT personnel: Their relationship to IS infrastructure and competitive advantage', *Decision Sciences*, vol. 32, no. 1, pp. 21-54.
Byrne, BM 2001, *Structural equation modeling with AMOS: Basic concepts, applications, and Programming*, Mahwah, NJ.
Byrne, SM & Javad, S 1992, *'Integrated logistics information systems (ILIS): competitive advantage or increased cost'*, Council of Logistics Management Annual Conference Proceedings, Oak Brook, IL, pp. 55-73.
Cachon, GP 2004, 'The allocation of inventory risk in a supply chain: Push, pull, and advance-purchase discount contracts', *Management Science*, vol. 50, no. 2, pp. 222-238.
Cachon, GP & Fisher, M 2000, 'Supply chain inventory management and the value of shared information', *Management Science*, vol. 46, no. 8, pp. 1032-1048.
Cachon, GP & Lariviere, MA 2001, 'Contracting to assure supply: How to share demand forecasts in a supply chain', *Management Science*, vol. 47, no. 5, pp. 629-646.
Cagliano, R, Caniato, F & Spina, G 2003, 'E-business strategy: how companies are shaping their supply chain through the Internet', *International Journal of Operations & Production Management*, vol. 23, no. 10, pp. 1142-1162.
Carr, AS & Kaynak, H 2007, 'Communication methods, information sharing, supplier development and performance', *International Journal of Operations & Production Management*, vol. 27, no. 4, pp. 346-370.

Carr, AS & Pearson, JN 1999, 'Strategically managed buyer–supplier relationships and performance outcomes', *Journal of Operations Management*, vol. 17, no. 5, pp. 497-519.
Carr, AS & Smeltzer, LR 2002, 'The relationship between information technology use and buyer-supplier relationships: an exploratory analysis of the buying firm's perspective', *IEEE Transactions on Engineering Management*, vol. 49, no. 3, pp. 293-304.
Carr, NG 2003, 'IT doesn't matter', *Harvard Business Review*, vol. 81, no. 12, pp. 66-67.
Carson, SJ, Devinney, TM, Dowling, GR & John, G 1999, 'Understanding institutional designs within marketing value systems', *The Journal of Marketing*, vol.64, Special Issue, pp. 115-130.
Cash, JI & Konsynski, BR 1985, 'IS redraws competitive boundaries', *Harvard Business Review*, vol. 63, no. 2, pp. 134-142.
Cash, JI, McKenney, JL & McFarlan, FW 1992, *Corporate information systems management: Text and cases,* McGraw-Hill Professional, NY.
Catalan, M & Kotzab, H 2003, 'Assessing the responsiveness in the Danish mobile phone supply chain', *International journal of Physical Distribution and Logistics Management*, vol. 33, no. 8, pp. 668-685.
Chaffey, D 2007, *E-business and E-commerce Management,* Prentice-Hall, Upper Saddle River, NJ.
Chan, HK & Chan, FTS 2009, 'Effect of information sharing in supply chains with flexibility', *International journal of Production Research*, vol. 47, no. 1, pp. 213-232.
Chandra, C & Kumar, S 2000, 'Supply chain management in theory and practice: a passing fad or a fundamental change?', *Industrial Management and Data Systems*, vol. 100, no. 3, pp. 100-133.
Chatfield, AT & Yetton, P 2000, 'Strategic payoff from EDI as a function of EDI embeddedness', *Journal of Management Information Systems*, vol. 16, no. 4, pp. 195-224.
Chatterjee, D, Segars, AH & Watson, RT 2006, 'Realizing the promise of e-business: developing and leveraging electronic partnering options', *California Management Review*, vol. 48, no. 4, pp. 60-83.
Chen, CH & Hsiao, YY 2008, 'The Effect of the Application of Information Technology and Strategic Partnership on the Firm Performance of Logistics Service Providers', *Journal of the Chinese Institute of Industrial Engineers*, vol. 25, no. 5, pp. 368-378.
Chen, F 1998, 'Echelon reorder points, installation reorder points, and the value of centralized demand information', *Management Science*, vol.44, no. 12, pp. 221-234.
Chen, F, Drezner, Z, Ryan, JK & Simchi-Levi, D 2000, 'Quantifying the bullwhip effect in a simple supply chain: The impact of forecasting, lead times, and information', *Management Science*, vol. 46, no. 3, pp. 436-443.
Chen, F, Federgruen, A & Zheng, YS 2001, 'Coordination mechanisms for a distribution system with one supplier and multiple retailers', *Management Science*, vol. 47, no. 5, pp. 693-708.
Chen, IJ & Paulraj, A 2004, 'Towards a theory of supply chain management: the constructs and measurements', *Journal of Operations Management*, vol. 22, no. 2, pp. 119-150.
Chen, IJ, Paulraj, A & Lado, AA 2004, 'Strategic purchasing, supply management, and firm performance', *Journal of operations management*, vol. 22, no. 5, pp. 505-523.
Cheney, PH & Lyons, NR 1980, 'Information systems skill requirements: A survey', *MIS Quarterly*, vol. 4, no. 1, pp. 35-43.

Chopra, S & Meindl, P 2001, *Supply chain management: strategy, planning and operation,* Prentice-Hall, Englewood Cliffs, NJ.
Chou, DC, Tan, X & Yen, DC 2004, 'Web technology and supply chain management', *Information Management and Computer Security*, vol. 12, no. 4, pp. 338-349.
Choudhury, V & Sampler, JL 1997, 'Information specificity and environmental scanning: an economic perspective', *MIS Quarterly*, vol. 21, no. 1, pp. 25-53.
Christiaanse, E & Kumar, K 2000, 'ICT enabled coordination of dynamic supply webs', *International Journal of Physical Distribution and Logistics Management*, vol. 30, no. 3/4, pp. 268-285.
Christopher, M 1999, 'Logistics and supply chain management: strategies for reducing cost and improving service', *International Journal of Logistics Research and Applications*, vol. 2, no. 1, pp. 103-104.
Christopher, M 2000, 'The agile supply chain competing in volatile markets', *Industrial Marketing Management*, vol. 29, no. 1, pp. 37-44.
Christopher, M & Towill, D 2000, 'Supply chain migration from lean and functional to agile and customised', *Supply Chain Management: An International Journal*, vol. 5, no. 4, pp. 206-213.
Christopher, M, Lowson, R & Peck, H 2004, 'Creating agile supply chains in the fashion industry', *International Journal of Retail & Distribution Management*, vol. 32, no. 8, pp. 367-376.
Christopher, M & Ryals, L 1999, 'Supply chain strategy: its impact on shareholder value', *International Journal of Logistics Management*, vol. 10, no. 1, pp. 1-10.
Churchill, GA 1979, 'A paradigm for developing better measures of marketing constructs', *Journal of Marketing Research*, vol. 16, Feb, pp. 64-73.
CILT (UK) 1998, *Glossary of Inventory and Materials Management Definitions*, viewed 15 May 2010, http://www.ciltuk.org.uk/download/scimglossary.pdf.
Clark, CE, Cavanaugh, NC, Brown, CV & Sambamurthy, V 1997, 'Building change-readiness capabilities in the IS organization: Insights from the Bell Atlantic experience', *MIS Quarterly*, vol. 21, no. 4, pp. 425-455.
Clarke, R 1992, 'A contingency model of EDI's impact on industry sectors', *The Journal of Strategic Information Systems*, vol. 1, no. 3, pp. 143-151.
Clemons, EK 1986, 'Information systems for sustainable competitive advantage', *Information and Management*, vol. 11, no. 3, pp. 131-136.
Clemons, EK 1991, 'Corporate strategies for information technology: A resource-based approach', *Computer*, vol. 24, no. 11, pp. 23-32.
Clemons, EK, Reddi, SP & Row, MC 1993, 'The impact of information technology on the organization of economic activity: the move to the middle hypothesis', *Journal of Management Information Systems*, vol. 10, no. 2, pp. 9-35.
Clemons, EK & Row, MC 1991, 'Sustaining IT advantage: the role of structural differences', *MIS Quarterly*, vol. 15, no. 3, pp. 275-292.
Clemons, EK & Row, MC 1992, 'Information technology and industrial cooperation: the changing economics of coordination and ownership', *Journal of Management Information Systems*, vol. 9, no. 2, pp. 9-28.
Clemons, EK & Row, MC 1993, 'Limits to interfirm coordination through information technology: Results of a field study in consumer packaged goods distribution', *Journal of Management Information Systems*, vol. 10, no. 1, pp. 73-95.
Closs, DJ, Swink, M & Nair, A 2005, 'The role of information connectivity in making flexible logistics programs successful', *International Journal of Physical Distribution & Logistics Management*, vol. 35, no. 4, pp. 258-277.

Coase, RH 1937, 'The nature of the firm', *Economica*, vol. 4, no. 16, pp. 386-405.
Coates, VT 1992, 'The future of information technology', *The Annals of the American Academy of Political and Social Science*, vol. 522, no. 1, pp. 45-56.
Collins, R, Bechler, K & Pires, S 1997, 'Outsourcing in the automotive industry: from JIT to modular consortia', *European Management Journal*, vol. 15, no. 5, pp. 498-508.
Collis, DJ 1994, 'Research note: how valuable are organizational capabilities?', *Strategic Management Journal*, vol. 15, pp. 143-152.
Collis, J, Hussey, J, Hussey, R & Inglis, R 2003, *Business Research: A practical guide for undergraduate and postgraduate students,* 2nd edn, Palgrave Macmillan, Basingstoke, NY.
Conner, KR 1991, 'A historical comparison of resource-based theory and five schools of thought within industrial organization economics: do we have a new theory of the firm?', *Journal of Management*, vol. 17, no. 1, pp. 121-154.
Cooley, WW 1978, 'Explanatory observational studies', *Educational Researcher*, vol. 7, no. 9, pp. 9-15.
Cooper, BL, Watson, HJ, Wixom, BH & Goodhue, DL 2000, 'Data warehousing supports corporate strategy at First American Corporation', *MIS Quarterly*, vol. 24, no. 4, pp. 547-567.
Cooper, DR & Schindler, PS 2003, *Business research methods,* Irwin/McGraw-Hill, Boston.
Cooper, MC & Ellram, LM 1993, 'Characteristics of supply chain management and the implications for purchasing and logistics strategy', *The International journal of Logistics Management*, vol. 4, no. 2, pp. 13-24.
Cooper, MC, Ellram, LM, Gardner, JT & Hanks, AM 1997, 'Meshing multiple alliances', *Journal of Business Logistics*, vol. 18, no. 1, pp. 67-89.
Cooper, MC, Lambert, DM & Pagh, JD 1997, 'Supply chain management: more than a new name for logistics', *The international Journal of Logistics Management*, vol. 8, no. 1, pp. 1-13.
Couger, JD, Davis, GB, Dologite, DG, Feinstein, DL, Gorgone, JT, Jenkins, AM, Kasper, GM, Little, JC, Longenecker Jr, HE & Valacich, JS 1995, 'IS'95: Guideline for undergraduate IS curriculum', *MIS Quarterly*, vol. 19, no. 3, pp. 341-359.
Cousins, PD 2005, 'The alignment of appropriate firm and supply strategies for competitive advantage', *International Journal of Operations & Production Management*, vol. 25, no. 5, pp. 403-428.
Cousins, PD, Lawson, B & Squire, B 2006, 'Supply chain management: theory and practice? the emergence of an academic discipline?', *International journal of Operations and Production Management*, vol. 26, no. 7, pp. 697-702.
Cox, A, Watson, G, Lonsdale, C & Sanderson, J 2004, 'Managing appropriately in power regimes: relationship and performance management in 12 supply chain cases', *Supply Chain Management: An International Journal*, vol. 9, no. 5, pp. 357-371.
Cragg, P, King, M & Hussin, H 2002, 'IT alignment and firm performance in small manufacturing firms', *The Journal of Strategic Information Systems*, vol. 11, no. 2, pp. 109-132.
Creswell, JW & Clark, VLP 2007, *Designing and conducting mixed methods research,* Sage, Thousand Oaks, CA.
Cronin, MJ 1997, 'Using the Web to push key data to decision makers', *Fortune,* vol. 29, September, p. 254.
Croom, S 2001, 'Restructuring supply chains through information channel innovation', *International journal of Operations and Production Management*, vol. 21, no. 4, pp. 504-515.

Croom, S, Romano, P & Giannakis, M 2000, 'Supply chain management: an analytical framework for critical literature review', *European journal of Purchasing and Supply Management*, vol. 6, no. 1, pp. 67-83.
Croom, SR 2005, 'The impact of e-business on supply chain management-an empirical study of key developments', *International journal of Operations and Production Management*, vol. 25, no. 1, pp. 55-73.
Cross, GJ 2000, 'How e-business is transforming supply chain management', *Journal of Business Strategy*, vol. 21, no. 2, pp.36-39.
Cross, J, Earl, MJ & Sampler, JL 1997, 'Transformation of the IT function at British Petroleum', *MIS Quarterly*, vol. 21, no. 4, pp. 401-423.
Croxton, KL, Garcia-Dastugue, SJ, Lambert, DM & Rogers, DS 2001, 'The supply chain management processes', *The international journal of Logistics Management*, vol. 12, no. 2, pp. 13-36.
Da Silveira, G 1998, 'A framework for the management of product variety', *International journal of Operations and Production Management*, vol. 18, no. 3, pp. 271-285.
Dahlstrom, R, McNeilly, KM & Speh, TW 1996, 'Buyer-seller relationships in the procurement of logistical services', *Journal of the Academy of Marketing Science*, vol. 24, no. 2, pp. 110-124.
Dahm, T 2000, *Getting and (keeping) a top search engine ranking*, viewed 5 May 2009 http://www.webdevelopersjournal.com/articles/get_keep_top_ranking.html.
Damanpour, F 1996, 'Organizational complexity and innovation: developing and testing multiple contingency models', *Management Science*, vol. 42, no. 5, pp. 693-716.
Danese, P, Romano, P & Vinelli, A 2004, 'Managing business processes across supply networks: the role of coordination mechanisms', *Journal of Purchasing and Supply Management*, vol. 10, no. 4-5, pp. 165-177.
Danielsson, M & Lundqvist, A 2005, *VMI and its effects on the small and medium-sized supplier*, thesis, Department of Management and Economics, Linköping University.
Daugherty, PJ, Myers, MB & Autry, CW 1999, 'Automatic replenishment programs: an empirical examination', *Journal of Business Logistics*, vol. 20, no. 2, pp. 63-82.
Davenport, TH 1998, 'Putting the enterprise into the enterprise system', *Harvard Business Review*, vol. 76, no. 4, pp. 121-131.
Davenport, TH & Short, J 1990, 'The New Industrial Engineering: Information Technology and Business Process Redesign', *Sloan Management Review*, vol. 31, no. 4, pp. 11-21.
Davenport, TH & Short, JE 2003, 'The new Industrial Engineering: Information technology and business process redesign', *Sloan Management Review*, vol. 31, no. 4, pp. 11-27.
Davis, D 2005, *Business research for decision making,* Thomson/Brooks/Cole, Belmont, California.
Davis, T 1993, 'Effective supply chain management', *Sloan Management Review*, Summer, pp. 35-46.
Dawson, TL, Fischer, KW & Stein, Z 2006, 'Reconsidering qualitative and quantitative research approaches: A cognitive developmental perspective', *New Ideas in Psychology*, vol. 24, no. 3, pp. 229-239.
Day, GS 1994, 'The capabilities of market-driven organizations', *The Journal of Marketing*, vol. 58, no. 4, pp. 37-52.
Day, GS & Nedungadi, P 1994, 'Managerial representations of competitive advantage', *The Journal of Marketing*, vol. 58, no. 2, pp. 31-44.
Day, GS & Wensley, R 1988, 'Assessing advantage: a framework for diagnosing competitive superiority', *The Journal of Marketing*, vol. 52, no. 2, pp. 1-20.
De Vaus, DA 2001, *Research design in social research,* Sage, London.

De Vaus, DA 2002, *Surveys in social research,* Routledge, London.
Dehning, B & Richardson, VJ 2002, 'Returns on investments in information technology: A research synthesis', *Journal of Information Systems*, vol. 16, no. 1, pp. 7-30.
Denzin, NK & Lincoln, YS 2007, *Strategies of qualitative inquiry,* Sage Publications, CA.
Dertouzos, ML & Gates, B 1997, *What will be: How the new world of information will change our lives,* Harper Edge, San Francisco.
Desouza, KC & Awazu, Y 2004, 'Need to Know- Organizational Knowledge and Management Perspective', *Information, Knowledge, Systems Management*, vol. 4, no. 1, pp. 1-14.
Dess, GG & Origer, NK 1987, 'Environment, structure, and consensus in strategy formulation: A conceptual integration', *Academy of Management Review*, vol. 12, no. 2, pp. 313-330.
Devaraj, S & Kohli, R 2000, 'Information technology payoff in the health-care industry: a longitudinal study', *Journal of Management Information Systems*, vol. 16, no. 4, pp. 41-67.
Devaraj, S & Kohli, R 2003, 'Performance impacts of information technology: is actual usage the missing link?', *Management Science*, vol. 49, no. 3, pp. 273-289.
Devaraj, S, Krajewski, L & Wei, JC 2007, 'Impact of eBusiness technologies on operational performance: the role of production information integration in the supply chain', *Journal of Operations Management*, vol. 25, no. 6, pp. 1199-1216.
DeVellis, RF 1991, *Scale development: Theory and applications,* Sage Publications, Newbury Park, CA.
DFAT, A-G 2010, *A global economy*, viewed 15 August 2010 http://www.dfat.gov.au/facts/global_economy.html.
Diaconis, P & Efron, B 1983, 'Computer-intensive methods in statistics', *Scientific American*, vol. 248, no. 5, pp. 116-130.
Disney, SM & Towill, DR 2003, 'The effect of vendor managed inventory (VMI) dynamics on the bullwhip effect in supply chains', *International journal of Production Economics*, vol. 85, no. 2, pp. 199-215.
Doll, WJ 1985, 'Avenues for top management involvement in successful MIS development', *MIS Quarterly*, vol. 9, no.1, pp. 17-35.
Dos Santos, B & Sussman, L 2000, 'Improving the return on IT investment: the productivity paradox', *International Journal of Information Management*, vol. 20, no. 6, pp. 429-440.
Duncan, NB 1995, 'Capturing flexibility of information technology infrastructure: A study of resource characteristics and their measure', *Journal of Management Information Systems*, vol. 12, no. 2, pp. 37-57.
Dyer, JH 1996, 'Specialized supplier networks as a source of competitive advantage: Evidence from the auto industry', *Strategic Management Journal*, vol. 17, no. 4, pp. 271-291.
Dyer, JH & Chu, W 2003, 'The role of trustworthiness in reducing transaction costs and improving performance: Empirical evidence from the United States, Japan, and Korea', *Organization Science*, vol. 14, no. 1, pp. 57-68.
Dyer, JH & Singh, H 1998, 'The relational view: Cooperative strategy and sources of interorganizational competitive advantage', *The Academy of Management Review*, vol. 23, no. 4, pp. 660-679.
Earl, MJ 1989, *Management strategies for information technology,* Prentice-Hall, Inc. Upper Saddle River, NJ.

Easterby-Smith, M, Thorpe, R & Lowe, A 2002, *Management research: An introduction,* Sage Publications, London.
El Sawy, OA 2001, 'Principles and tactics or process redesign for e-business', *Redesigning Enterprise Processes for E-business*, Irwin/McGraw-Hill Mass, Boston.
Elmes, DG, Kantowitz, BH & Roediger, HL 1995, *Research methods in psychology,* West Publishing Company, St. Paul, MN.
Enders, CK 2002, 'Applying the Bollen-Stine bootstrap for goodness-of-fit measures to structural equation models with missing data', *Multivariate Behavioral Research*, vol. 37, no. 3, pp. 359-377.
Eng, TY 2004, 'The role of e-marketplaces in supply chain management', *Industrial Marketing Management*, vol. 33, no. 2, pp. 97-105.
Eppen, GD & Iyer, AV 1997, 'Backup agreements in fashion buying-the value of upstream flexibility', *Management Science*, vol. 43, no. 11, pp. 1469-1484.
Evans, GN, Nairn, MM, Towill, DR 1993, 'Dynamic Supply Chain Performance: assessing the impact of information system', *Logistics Information Management*, vol. 6, no. 4, pp. 15-25.
Fabbe-Costes, N & Jahre, M 2007, 'Supply chain integration improves performance: the Emperor's new suit?', *International journal of Physical Distribution and Logistics Management*, vol. 37, no. 10, pp. 835-855.
Fahy, J, Hooley, G, Cox, T, Beracs, J, Fonfara, K & Snoj, B 2000, 'The Development and Impact of Marketing Capabilities in Central Europe', *Journal of International Business Studies*, vol. 31, no. 1, pp. 63-81.
Fahy, J & Smithee, A 1999, 'Strategic marketing and the resource based view of the firm', *Academy of Marketing Science Review*, vol. 99, no.10, pp. 1-21.
Faisal, MN, Banwet, DK & Shankar, R 2007, 'Information risks management in supply chains: an assessment and mitigation framework', *Journal of Enterprise Information Management*, vol. 20, no. 6, pp. 677-699.
Farley, JU & Webster Jr, FE 1993, 'Corporate culture, customer orientation, and innovativeness in Japanese firms: a quadrad analysis', *The Journal of Marketing*, vol. 57, no. 1, pp. 23-37.
Fawcett, SE & Clinton, SR 1997, 'Enhancing logistics to improve the competitiveness of manufacturing organizations: a triad perspective', *Transportation Journal*, vol. 37, no. 1, pp. 18-28.
Fawcett, SE & Magnan, GM 2002, 'The rhetoric and reality of supply chain integration', *International journal of Physical Distribution and Logistics Management*, vol. 32, no. 5, pp. 339-361.
Fawcett, SE, Ogden, JA, Magnan, GM & Cooper, MB 2006, 'Organizational commitment and governance for supply chain success', *International journal of Physical Distribution and Logistics Management*, vol. 36, no. 1, pp. 22-35.
Feeny, DF & Willcocks, LP 1998, 'Core IS capabilities for exploiting information technology', *Sloan Management Review*, vol. 39, no. 3, pp. 9-21.
Feitzinger, E & Lee, HL 1997, 'Mass customization at Hewlett-Packard: the power of postponement', *Harvard Business Review*, vol. 75, no. 1, pp. 116-123.
Ferrer, M, Santa, R, Hyland, PW & Bretherton, P, 'Relational factors that explain supply chain relationships', Asia Pacific Journal of Marketing and Logistics, vol.22, no.3, pp. 419-440.
Fine, CH 2000, 'Clockspeed-based strategies for supply chain design', *Production and Operations Management*, vol. 9, no. 3, pp. 213-221.

Fink, D 1998, 'Guidelines for the successful adoption of information technology in small and medium enterprises', *International Journal of Information Management*, vol. 18, no. 4, pp. 243-253.
Fink, L & Neumann, S 2007, 'Gaining agility through IT personnel capabilities: The mediating role of IT infrastructure capabilities', *Journal of the Association for Information Systems*, vol. 8, no. 8, pp. 440-462.
Fiorito, SS, May, EG & Straughn, K 1995, 'Quick response in retailing: components and implementation', *International Journal of Retail & Distribution Management*, vol. 23, no. 5, pp. 12-21.
Fisher, M, Rajaram, K & Raman, A 2001, 'Optimizing inventory replenishment of retail fashion products', *Manufacturing & Service Operations Management*, vol. 3, no. 3, pp. 230-241.
Fisher, ML 1997, 'What is the right supply chain for your product?', *Harvard Business Review*, vol. 75, no. 2, pp. 105-116.
Fisher, ML, Hammond, JH, Obermeyer, WR & Raman, A 1994, 'Making supply meet demand in an uncertain world', *Harvard Business Review*, May/June, pp. 83-93.
Fisher, RJ, Maltz, E & Jaworski, BJ 1997, 'Enhancing communication between marketing and engineering: the moderating role of relative functional identification', *The Journal of Marketing*, vol. 61, no. 3, pp. 54-70.
Fliedner, G 2003, 'CPFR: an emerging supply chain tool', *Industrial Management and Data Systems*, vol. 103, no. 1, pp. 14-21.
Forrest, E 1999, *Internet marketing research: Resources and techniques,* McGraw-Hill, NY.
Forrester, JW & Wright, J 1961, *Industrial dynamics,* MIT press Cambridge, MA.
Forrester, JW 1958, Industrial dynamics: a major breakthrough for decision makers*, Harvard Business Review,* vol. 36, no. 4, pp. 37-66.
Fowler, FJ 2008, *Survey research methods,* Sage Publications, Thousand Oaks, CA.
Frambach, RT & Schillewaert, N 2002, 'Organizational innovation adoption: a multi-level framework of determinants and opportunities for future research', *Journal of Business Research*, vol. 55, no. 2, pp. 163-176.
Frazelle, EH 2001, *Supply chain strategy: the logistics of supply chain management,* McGraw-Hill, NY.
Frazier, GL 1999, 'Organizing and managing channels of distribution', *Journal of the Academy of Marketing Science*, vol. 27, no. 2, pp. 226-240.
Freedman, R 1999, 'ERP Beyond Y2K', *PC Magazine,* vol. 22, June, p. 219.
Freiden, J, Goldsmith, R, Takacs, S & Hofacker, C 1998, 'Information as a product: not goods, not services', *Marketing Intelligence and Planning*, vol. 16, no. 3, pp. 210-220.
Frohlich, MT 2002a, 'E-integration in the supply chain: barriers and performance', *Decision Sciences*, vol. 33, no. 4, pp. 537-556.
Frohlich, MT 2002b, 'Techniques for improving response rates in OM survey research', *Journal of Operations Management*, vol. 20, no. 1, pp. 53-62.
Frohlich, MT & Westbrook, R 2001, 'Arcs of integration: an international study of supply chain strategies', *Journal of Operations Management*, vol. 19, no. 2, pp. 185-200.
Frohlich, MT & Westbrook, R 2002, 'Demand chain management in manufacturing and services: web-based integration, drivers, and performance', *Journal of Operations Management*, vol. 20, no. 6, pp. 729-745.
Fry, MJ, Kapuscinski, R & Olsen, TL 2001, 'Coordinating production and delivery under a (z, Z)-type vendor-managed inventory contract', *Manufacturing & Service Operations Management*, vol. 3, no. 2, pp. 151-173.

Fugate, B, Sahin, F & Mentzer, JT 2006, 'Supply chain management coordination mechanisms', *Journal of Business Logistics*, vol. 27, no. 2, pp. 129-161.
Gadde, LE & Håkansson, H 2001, *Supply network strategies,* John Wiley & Sons Inc, Chichester.
Gallivan, MJ & Depledge, G 2003, 'Trust, control and the role of interorganizational systems in electronic partnerships', *Information Systems Journal*, vol. 13, no. 2, pp. 159-190.
Ganeshan, R & Marath, RK 2002, *Web-enabling the supply chain: an exploratory case study,* Amacom, New York.
Gangopadhyay, A & Huang, Z 2004, 'Studying the value information sharing in ebusiness supply chain management', *Journal of International Technology and Information Management*, vol. 13, no. 1, pp. 49-60.
Garcia-Dastugue, SJ & Lambert, DM 2003, 'Internet-enabled coordination in the supply chain', *Industrial Marketing Management*, vol. 32, no. 3, pp. 251-263.
Gardiner, SC, Hanna, JB & LaTour, MS 2002, 'ERP and the reengineering of industrial marketing processes A prescriptive overview for the new-age marketing manager', *Industrial Marketing Management*, vol. 31, no. 4, pp. 357-365.
Gattorna, J 1998, *Strategic supply chain alignment (best practice in supply chain management),* Gower, Brookfield, VT.
Gavirneni, S, Kapuscinski, R & Tayur, S 1999, 'Value of information in capacitated supply chains', *Management Science*, vol. 45, no. 1, pp. 16-24.
Gefen, D, Straub, D & Boudreau, MC 2000, 'Structural equation modeling and regression: Guidelines for research practice', *Communications of the Association for Information Systems*, vol. 4, no. 1, pp.1-76.
Germain, R & Iyer, KNS 2006, 'The interaction of internal and downstream integration and its association with performance', *Journal of Business Logistics*, vol. 27, no. 2, pp. 29-52.
Gerstner, E & Hess, JD 1995, 'Pull promotions and channel coordination', *Marketing Science*, vol. 14, no. 1, pp. 43-60.
Giddings, LS & Grant, BM 2007, 'A Trojan Horse for Positivism?: A Critique of Mixed Methods Research', *Advances in Nursing Science*, vol. 30, no. 1, pp. 52-60.
Gilbert, SM & Ballou, RH 1999, 'Supply chain benefits from advanced customer commitments', *Journal of Operations Management*, vol. 18, no. 1, pp. 61-73.
Gilmore, JH & Pine, BJ 1997, 'The four faces of mass customization', *Harvard Business Review*, vol. 75, no. 1, pp. 91-101.
Gilmour, P, Driva, H & Hunt, RA 1995, 'Future directions for logistics in Australia', *International journal of Physical Distribution and Logistics Management*, vol. 25, no. 3, pp. 24-32.
Gindy, NN, Saad, SM & Yue, Y 1999, 'Manufacturing responsiveness through integrated process planning and scheduling', *International journal of Production Research*, vol. 37, no. 11, pp. 2399-2418.
Giunipero, LC, Hooker, RE, Joseph-Matthews, S, Yoon, T & Brudvig, S 2008, 'A decade of SCM literature: Past, present and future implications', *Journal of Supply Chain Management*, vol. 44, no. 4, pp. 66-86.
Golicic, SL, Davis, DF, McCarthy, TM & Mentzer, JT 2002, 'The impact of e-commerce on supply chain relationships', *An international journal of Physical Distribution and Logistics Management*, vol. 32, no. 10, pp. 851-871.
González-Benito, Ó & González-Benito, J 2005, 'Cultural vs. operational market orientation and objective vs. subjective performance: perspective of production and operations', *Industrial Marketing Management*, vol. 34, no. 8, pp. 797-829.

Gosain, S, Malhotra, A & El Sawy, OA 2004, 'Coordinating for flexibility in e-business supply chains', *Journal of Management Information Systems*, vol. 21, no. 3, pp. 7-45.
Grant, RM 1991, 'The resource-based theory of competitive advantage', vol. 33, no. 3, pp. 114-135.
Grant, RM 1996, 'Toward a knowledge-based theory of the firm', *Strategic Management Journal,* vol. 17, Winter Special Issue, pp. 109-122.
Grant, RM 1998, *Contemporary strategic analysis,* Basic Blackwell, Oxford.
Green, GI 1989, 'Perceived importance of systems analysts' job skills, roles, and non-salary incentives', *MIS Quarterly*, vol. 13, no. 2, pp. 115-133.
Griffiths, J & Margetts, D 2000, 'Variation in production schedules—implications for both the company and its suppliers', *Journal of Materials Processing Tech.*, vol. 103, no. 1, pp. 155-159.
Grossman, SJ & Hart, OD 1986, 'The costs and benefits of ownership: A theory of vertical and lateral integration', *The Journal of Political Economy*, vol. 94, no. 4, pp. 691-719.
Grover, V & Malhotra, MK 2003, 'Transaction cost framework in operations and supply chain management research: theory and measurement', *Journal of Operations Management*, vol. 21, no. 4, pp. 457-473.
GS1 Australia 2010, *Home page- GS1 Australia*, viewed 12 June 2010, http://www.gs1au.org/index.asp.
GS1 Organization 2010, *Home page- GS1 Australia*, viewed 12 June 2010, http://www.GS1.org/.
Gunasekaran, A, Lai, K & Edwin Cheng, TC 2008, 'Responsive supply chain: a competitive strategy in a networked economy', *Omega*, vol. 36, no. 4, pp. 549-564.
Gunasekaran, A & Ngai, EWT 2004, 'Information systems in supply chain integration and management', *European journal of Operational Research*, vol. 159, no. 2, pp. 269-295.
Gundlach, GT, Achrol, RS & Mentzer, JT 1995, 'The structure of commitment in exchange', *The Journal of Marketing*, vol. 59, no. 1, pp. 78-92.
Guo, Z, Fang, F & Whinston, AB 2006, 'Supply chain information sharing in a macro prediction market', *Decision Support Systems*, vol. 42, no. 3, pp. 1944-1958.
Gupta, D & Weerawat, W 2006, 'Supplier–manufacturer coordination in capacitated two-stage supply chains', *European Journal of Operational Research*, vol. 175, no. 1, pp. 67-89.
Gurbaxani, V & Whang, S 1991, 'The impact of information systems on organizations and markets', *Communications of the ACM*, vol. 34, no. 1, pp. 59-73.
Gustin, CM, Daugherty, PJ & Stank, TP 1995, 'The effects of information availability on logistics integration', *Journal of Business Logistics*, vol. 16, no. 1, pp. 1-21.
Gustin, CM, Stank, TP & Daugherty, PJ 1994, 'Computerization: supporting integration', *International Journal of Physical Distribution & Logistics Management*, vol. 24, no. 1, pp. 11-16.
Hadaya, P 2008, 'Determinants and Performance Outcome of SMEs' Use of Vertical B-to-B e-Marketplaces to Sell Products', *Electronic Markets*, vol. 18, no. 3, pp. 260-274.
Hair, JF, Anderson, RE, Tatham, RL & Black, WC 2003, *Multivariate data analysis,* 6th edn., Pearson Prentice Hall, Upper Saddle River, NJ.
Håkansson, H 1989, 'No business is an island: The network concept of business strategy', *Scandinavian Journal of Management*, vol. 5, no. 3, pp. 187-200.
Hammel, TR & Kopczak, LR 1993, 'Tightening the supply chain', *Production and Inventory Management Journal*, vol. 34, no. 2, pp. 63-70.

Hammer, M 1990, 'Reengineering work: don't automate, obliterate', *Harvard Business Review*, vol. 68, no. 4, pp. 104-112.
Hammer, M & Champy, J 1993, *Business process reengineering: A manifesto for business revolution,* Harper Business, New York.
Hammer, M & Mangurian, GE 1990, *The changing value of communications technology,* Scott, Foresman & Co., Glenview, IL.
Han, JK, Kim, N & Srivastava, RK 1998, 'Market orientation and organizational performance: is innovation a missing link?', *The Journal of Marketing*, vol. 62, no. 4, pp. 30-45.
Handfield, RB & Nichols Jr, EL 2002, *Supply chain redesign: Transforming supply chains into integrated value systems,* Financial Times Prentice Hall, Upper Sadlle River, NJ.
Hannula, M & Vasama, T 2002, '*The Contribution of RosettaNet E-Business Standard*' eBRF, Tampere, Finland.
Harkness, WL, Kettinger, WJ & Segars, AH 1996, 'Sustaining process improvement and innovation in the information services function: lessons learned at the Bose corporation', *MIS Quarterly*, vol. 20, no. 3, pp. 349-368.
Harland, CM 1996, 'Supply chain management: relationships, chains and networks', *British journal of Management*, vol. 7, Special Issue, pp. 63-80.
Harland, CM, Caldwell, ND, Powell, P & Zheng, J 2007, 'Barriers to supply chain information integration: SMEs adrift of eLands', *Journal of Operations Management*, vol. 25, no. 6, pp. 1234-1254.
Harland, CM, Lamming, RC & Cousins, PD 1999, 'Developing the concept of supply strategy', *International journal of Operations and Production Management*, vol. 19, no. 7, pp. 650-673.
Harrigan, KR 1986, 'Matching vertical integration strategies to competitive conditions', *Strategic Management Journal*, vol. 7, no. 6, pp. 535-555.
Harris, SE & Katz, JL 1991, 'Organizational performance and information technology investment intensity in the insurance industry', *Organization Science*, vol. 2, no. 3, pp. 263-295.
Harrison, A 1996, 'An investigation of the impact of schedule stability on supplier responsiveness', *International Journal of Logistics Management*, vol. 7, no. 1, pp. 83-92.
Harrison, A & Godsell, J 2003, Customer responsive supply chains An exploratory study of performance measurement, Cranfield University, School of Management-Working Paper Series, United Kingdom, pp. 1-13.
Harrison, W & Springer, D 1984, 'A software systems management MBA option', *ACM SIGMIS Database*, vol. 16, no. 2, pp. 19-23.
Harwood, TG & Garry, T 2003, 'An overview of content analysis', *The Marketing Review*, vol. 3, no. 4, pp. 479-498.
Hayes, RH & Pisano, G 1994, 'The New Manufacturing Strategy in', *Harvard Business Review*, vol. 72, no. 1, pp. 77-87.
Hayes, RH & Wheelwright, SC 1984, *Restoring our competitive edge,* Wiley, New York.
Hayes, RH, Wheelwright, SC & Clark, KB 1988, *Dynamic manufacturing,* Free Press, New York.
Heide, JB & John, G 1990, 'Alliances in industrial purchasing: the determinants of joint action in buyer-supplier relationships', *Journal of Marketing Research*, vol. 27, no. 1, pp. 24-36.

Henderson, C, Kelly, ME & Beaumont, N 2003, *Business without borders:e-business and the international community*, viewed 10 June 2010, http://cms-public.buseco.monash.edu.au/mgt/research/working-papers/2003/wp44-03.pdf.
Henderson, JC & Venkatraman, N 1993, 'Strategic alignment: Leveraging information technology for transforming organizations', *IBM systems Journal*, vol. 32, no. 1, pp. 4-16.
Hernández-Espallardo, M & Arcas-Lario, N 2003, 'The effects of authoritative mechanisms of coordination on market orientation in asymmetrical channel partnerships', *International Journal of Research in Marketing*, vol. 20, no. 2, pp. 133-152.
Heskett, JL, Glaskowsky Jr, NA, Ivie, RM & Glaskowsky, NA 1973, *Business logistics: physical distribution and materials management,* Ronald Press Company, NY.
Higginson, JK & Alam, A 1997, 'Supply chain management techniques in medium-to-small manufacturing firms', *The international journal of Logistics Management*, vol. 8, no. 2, pp. 19-32.
Hilty, LM 2005, 'Electronic waste-an emerging risk?', *Environmental Impact Assessment Review*, vol. 25, no. 5, pp. 431-435.
Hines, P, Rich, N & Hittmeyer, M 1998, 'Competing against ignorance: advantage through knowledge', *International journal of physical distribution and logistics management*, vol. 28, no. 1, pp. 18-43.
Hodge, G 2002, 'Enterprise resource planning in textiles', *Journal of Textile and Apparel, Technology and Management*, vol. 2, no. 3, pp. 1-8.
Holcomb, MC 1994, 'Customer service measurement: a methodology for increasing customer value through utilization of the Taguchi strategy', *Journal of Business Logistics*, vol. 15, no. 1, pp. 29-52.
Holland, C, Lockett, G & Blackman, I 1992, 'Planning for electronic data interchange', *Strategic Management Journal*, vol. 13, no. 7, pp. 539-550.
Holmberg, S 2000, 'A systems perspective on supply chain measurements', *International Journal of Physical Distribution and Logistics Management*, vol. 30, no. 9/10, pp. 847-868.
Holmes-Smith, P 2007, *An applied introductory course in structural equation modelling using AMOS,* SREAMS, Melbourne.
Holsti, OR 1968, 'Content analysis for social science and humanities', *The handbook of social psychology*, Addison-Wesley, MA.
Holweg, M 2005, 'The three dimensions of responsiveness', *International journal of Operations and Production Management*, vol. 25, no. 7, pp. 603-622.
Horvath, L 2001, 'Collaboration: the key to value creation in supply chain management', *Supply Chain Management: An International Journal*, vol. 6, no. 5, pp. 205-207.
Houlihan, JB 1985, 'International supply chain management', *International Journal of Physical Distribution and Materials Management*, vol. 15, no. 1, pp. 22-38.
Hsieh, HF & Shannon, SE 2005, 'Three approaches to qualitative content analysis', *Qualitative Health Research*, vol. 15, no. 9, pp. 1277-1288.
Hsu, CC, Kannan, VR, Tan, KC & Leong, GK 2008, 'Information sharing, buyer-supplier relationships, and firm performance', *International Journal of Physical Distribution & Logistics Management*, vol. 38, no. 4, pp. 296-310.
Hu, L & Bentler, PM 1998, 'Fit indices in covariance structure modeling: Sensitivity to under parameterized model misspecification', *Psychological Methods*, vol. 3, no. 4, pp. 424-453.

Huber, GP 1990, 'A theory of the effects of advanced information technologies on organizational design, intelligence, and decision making', *Academy of Management Review*, vol. 15, no. 1, pp. 47-71.
Hulland, J & Wade, M 2004, 'The resource-based view and information systems research: review, extension, and suggestions for future research', *MIS Quarterly*, vol. 28, no. 1, pp. 107-142.
Hult, GTM, Ketchen, DJ, Cavusgil, ST & Calantone, RJ 2006, 'Knowledge as a strategic resource in supply chains', *Journal of Operations Management*, vol. 24, no. 5, pp. 458-475.
Hunt, SD 1991, *Modern marketing theory: Critical issues in the philosophy of marketing science,* South-Western Cincinnati, OH.
Inman, RR & Gonsalvez, DJA 1997, 'Measuring and analysing supply chain schedule stability: a case study in the automotive industry', *Production Planning and Control*, vol. 8, no. 2, pp. 194-204.
Ireland, P 1999, 'Satisficing dependent customers: on the power of suppliers in IT systems integration supply chains', *Supply Chain Management: An International Journal*, vol. 4, no. 4, pp. 184-91.
Iyer, AV & Bergen, ME 1997, 'Quick response in manufacturer-retailer channels', *Management Science*, vol. 43, no. 4, pp. 559-570.
Janah, M 1998, 'Unified Front-Prudential's IT Must Engage Customers And Pull Together The Company's Units', *InformationWeek*, July, p. 38.
Jap, SD 2001, 'Perspectives on joint competitive advantages in buyer–supplier relationships', *International Journal of Research in Marketing*, vol. 18, pp. 19-35.
Jarvenpaa, SL & Leidner, DE 1997, 'An information company in Mexico: extending the resource-based view of the firm to a developing country context', *Association for Information Systems Atlanta*, vol. 9, no.4, pp. 342-361.
Jarvenpaa, SL & Todd, PA 1996, 'Consumer reactions to electronic shopping on the World Wide Web', *International Journal of Electronic Commerce*, vol. 1, no. 2, pp. 59-88.
Jaworski, BJ & Kohli, AK 1993, 'Market orientation: antecedents and consequences', *The Journal of Marketing*, vol. 57, no. 3, pp. 53-70.
Jean, R-JB 2007, 'The ambiguous relationship of ICT and organizational performance: a literature review', *Critical Perspectives on International Business*, vol. 3, no. 4, pp. 306-321.
Jean, R-JB, Sinkovics, RR & Kim, D 2008, 'Information technology and organizational performance within international business to business relationships (a review and an integrated conceptual framework)', *International Marketing Review*, vol. 25, no. 5, pp. 563-583.
Jeffers, PI 2003, '*Information technology (IT) and process performance: an empirical investigation of the complementarities between IT and non-IT resources*', Thesis, Graduate School of the Ohio State University, The Ohio State University.
Jeffers, PI, Muhanna, WA & Nault, BR 2008, 'Information technology and process performance: an empirical investigation of the interaction between IT and Non-IT resources', *Decision Sciences*, vol. 39, no. 4, pp. 403-434.
Jeffrey, P & Salancik, GR 1978, *The External Control of Organizations: A Resource Dependence Perspective,* Harper & Row, New York.
Jenkins, GH 1986, 'Education requirements for the entry level business systems analyst', *Journal of Systems Management*, vol. 37, no. 8, pp. 30-33.
Jensen, M & Meckling, W 1976, 'Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure', *Journal of Financial Economics*, vol. 3, no. 4, pp. 305-360.

Jeuland, AP & Shugan, SM 1983, 'Managing channel profits', *Marketing Science*, vol. 2, no. 3, pp. 239-272.
Jobber, D & O'Reilly, D 1998, 'Industrial Mail Surveys A Methodological Update', *Industrial Marketing Management*, vol. 27, no. 2, pp. 95-107.
Jogaratnam, G, Tse, EC & Olsen, MD 1999, 'An empirical analysis of entrepreneurship and performance in the restaurant industry', *Journal of Hospitality & Tourism Research*, vol. 23, no. 4, pp. 339-353.
Johnson, JL 1999, 'Strategic integration in industrial distribution channels: managing the interfirm relationship as a strategic asset', *Journal of the Academy of Marketing Science*, vol. 27, no. 1, pp. 4-18.
Johnson, SA & Houston, MB 2000, 'Buyer-supplier contracts versus joint ventures: determinants and consequences of transaction structure', *Journal of Marketing Research*, vol. 37, no. 1, pp. 1-15.
Jones, C, Hesterly, WS & Borgatti, SP 1997, 'A general theory of network governance: Exchange conditions and social mechanisms', *The Academy of Management Review*, vol. 22, no. 4, pp. 911-945.
Jones, TC & Riley, DW 1985, 'Using inventory for competitive advantage through supply chain management', *International Journal of Physical Distribution and Materials Management*, vol. 15, no. 5, pp. 16-26.
Jöreskog, KG 1977, 'Structural equation models in the social sciences: Specification, estimation and testing', *Applications of statistics*, Amsterdam: North-Holland.
Jorgensen, S & Zaccour, G 2003, 'Channel coordination over time: incentive equilibria and credibility', *Journal of Economic Dynamics and Control*, vol. 27, no. 5, pp. 801-822.
Kaipia, R, Holmström, J & Tanskanen, K 2002, 'VMI: What are you losing if you let your customer place orders?', *Production Planning & Control*, vol. 13, no. 1, pp. 17-25.
Kaipia, R & Tanskanen, K 2003, 'Vendor managed category management—an outsourcing solution in retailing', *Journal of Purchasing and Supply Management*, vol. 9, no. 4, pp. 165-175.
Kambil, A & Short, JE 1994, 'Electronic integration and business network redesign: a roles-linkage perspective', *Journal of Management Information Systems*, vol. 10, no. 4, pp. 59-83.
Kannan, VR & Handfield, RB 1998, 'Supply chain management: supplier performance and firm performance', *International Journal of Purchasing and Materials Management*, vol. 34, no. 3, pp. 2-9.
Kaplan, D & Elliott, PR 1997, 'A didactic example of multilevel structural equation modeling applicable to the study of organizations', *Structural Equation Modeling: A Multidisciplinary Journal*, vol. 4, no. 1, pp. 1-24.
Kardaras, D & Karakostas, B 1999, 'The use of fuzzy cognitive maps to stimulate the information systems strategic planning process', *Information and Software Technology* vol. 41, no.4, pp. 197-210.
Kassarjian, HH 1977, 'Content analysis in consumer research', *Journal of Consumer Research*, vol. 4, no. 1, pp. 8-18.
Kearns, GS & Lederer, AL 2000, 'The effect of strategic alignment on the use of IS-based resources for competitive advantage', *Journal of Strategic Information Systems*, vol. 9, no. 4, pp. 265-293.
Kearns, GS & Lederer, AL 2003, 'A resource-based view of strategic IT alignment: How knowledge sharing creates competitive advantage', *Decision Sciences*, vol. 34, no. 1, pp. 1-29.

Kendall, KE 1997, 'The Significance of Information Systems Research on Emerging Technologies: Seven Information Technologies that Promise to Improve Managerial Effectiveness', *Decision Sciences*, vol. 28, no. 4, pp. 775-792.
Kettinger, WJ, Grover, V, Guha, S & Segars, AH 1994, 'Strategic information systems revisited: a study in sustainability and performance', *MIS Quarterly*, vol. 18, no. 1, pp. 31-58.
Kim, D & Cavusgil, E 2009, 'The impact of supply chain integration on brand equity', *Journal of Business & Industrial Marketing*, vol. 24, no. 7, pp. 496-505.
Kim, D, Cavusgil, ST & Calantone, RJ 2005, 'The role of information technology in supply-chain relationships: does partner criticality matter?', *Journal of Business & Industrial Marketing*, vol. 20, no. 4/5, pp. 169-178.
Kim, D, Cavusgil, ST & Calantone, RJ 2006, 'Information system innovations and supply chain management: channel relationships and firm performance', *Journal of the Academy of Marketing Science*, vol. 34, no. 1, pp. 40-54.
Kim, KK & Umanath, NS 1999, 'An empirical investigation of electronic integration in a supply chain relationship', Proceedings of the 20th International Conference on Information Systems, Charlotte, North Carolina, pp.546-551.
Kim, KK & Umanath, NS 2005, 'Information transfer in B2B procurement: an empirical analysis and measurement', *Information & Management*, vol. 42, no. 6, pp. 813-828.
Kim, KK, Umanath, NS & Kim, BH 2006, 'An assessment of electronic information transfer in B2B supply-channel relationships', *Journal of Management Information Systems*, vol. 22, no. 3, pp. 294-320.
Kim, SM & Mahoney, JT 2006, 'Mutual commitment to support exchange: relation-specific it system as a substitute for managerial hierarchy', *Strategic Management Journal*, vol. 27, no. 5, pp. 401-423.
Kim, SW 2006, 'The effect of supply chain integration on the alignment between corporate competitive capability and supply chain operational capability', *International Journal of Operations & Production Management*, vol. 26, no. 10, pp. 1084-1107.
Kim, SW & Narasimhan, R 2002, 'Information system utilization in supply chain integration efforts', *International journal of Production Research*, vol. 40, no. 18, pp. 4585-4609.
Kinra, A & Kotzab, H 2008, 'A macro-institutional perspective on supply chain environmental complexity', *International journal of Production Economics*, vol. 115, no. 2, pp. 283-295.
Kirchmer, M 2004, 'E-business process networks-successful value chains through standards', *Journal of Enterprise Information Management*, vol. 17, no. 1, pp. 20-30.
Kline, RB 2005, *Principles and practice of structural equation modeling,* Guilford Press, NY.
Koh, SCL & Maguire, S 2004, 'Identifying the adoption of e-business and knowledge management within SMEs', *Journal of Small Business and Enterprise Development*, vol. 11, no. 3, pp. 338-348.
Kohli, R & Grover, V 2008, 'Business value of IT: an essay on expanding research directions to keep up with the times', *Journal of the Association for Information Systems*, vol. 9, no. 1, pp. 23-39.
Koufteros, X, Vonderembse, M & Jayaram, J 2005, 'Internal and external integration for product development: The contingency effects of uncertainty, equivocality, and platform strategy', *Decision Sciences*, vol. 36, no. 1, pp. 97-133.
Krajewski, L, Wei, JC & Tang, LL 2005, 'Responding to schedule changes in build-to-order supply chains', *Journal of Operations Management*, vol. 23, no. 5, pp. 452-469.

Kritchanchai, D & MacCarthy, BL 1999, 'Responsiveness of the order fulfilment process', *International Journal of Operations and Production Management*, vol. 19, no. 8, pp. 812-833.
Kuhn, TS 1970, *The structure of scientific revolutions,* 2nd edn*,* University of Chicago Press Chicago, US.
Kumar, R 2005, *Research methodology: A step-by-step guide for beginners,* Sage, London.
Kumar, S & Seth, A 1998, 'The design of coordination and control mechanisms for managing joint venture-parent relationships', *Strategic Management Journal*, vol. 19, no. 6, pp. 579-599.
Kumar, S & Thondikulam, G 2006, 'Knowledge management in a collaborative business framework', *Information, Knowledge, Systems Management*, vol. 5, no. 3, pp. 171-187.
Lado, AA, Boyd, NG & Wright, P 1992, 'A competency-based model of sustainable competitive advantage: Toward a conceptual integration', *Journal of Management*, vol. 18, no. 1, pp. 77-91.
Lai, KH, Wong, CWY & Cheng, TCE 2008, 'A coordination-theoretic investigation of the impact of electronic integration on logistics performance', *Information & Management*, vol. 45, no. 1, pp. 10-20.
Lambert, DM & Cooper, MC 2000, 'Issues in supply chain management', *Industrial Marketing Management*, vol. 29, no. 1, pp. 65-83.
Lambert, DM, Cooper, MC & Pagh, JD 1998, 'Supply chain management: implementation issues and research opportunities', *International Journal of Logistics Management*, vol. 9, no. 2, pp. 1-20.
Lamming, R & Hampson, J 1996, 'The environment as a supply chain management issue', *British journal of Management*, vol. 7, Special Issue, pp. 45-62.
Lampel, J & Mintzberg, H 1996, 'Customizing customization', *Sloan Management Review*, vol. 38, no. 1, pp. 21-30.
Lancaster, K 1990, 'The economics of product variety: A survey', *Marketing Science*, vol.9, no.3, pp. 189-206.
Lancioni, R, Schau, HJ & Smith, MF 2003, 'Internet impacts on supply chain management', *Industrial Marketing Management*, vol. 32, no. 3, pp. 173-175.
Lancioni, RA, Smith, MF & Oliva, TA 2000, 'The role of the internet in supply chain management', *Industrial Marketing Management*, vol. 29, no. 1, pp. 45-56.
Lapide, L 1999, 'New developments in business forecasting', *Journal of Business Forecasting Methods and Systems*, vol. 18, no. 3, pp. 24-25.
Lariviere, MA 1999, '*Supply chain contracting and coordination with stochastic demand'*, S. Tayur, R. Ganeshan, M. Magazine (Eds), Quantitative models for supply chain management, Kluwer, Norwell, MA.
Laud, RL & Thies, PK 1997, 'Great expectations: structuring IT organizations that really deliver', *Business horizons*, vol. 40, no. 4, pp. 25-36.
Laudon, KC, Laudon, JP & Filip, FG 2004, *Management information systems: managing the digital firm,* Citeseer, New Jersey.
Laudon, KC & Traver, CG 2001, *E-commerce: Business.Technology. Society,* Addison-Wesley Longman, Boston, MA.
Lederer, AL & Mendelow, AL 1988, 'Convincing top management of the strategic potential of information systems', *MIS Quarterly*, vol. 12, no. 4, pp. 525-534.
Lee, HL 2000, 'Creating value through supply chain integration', *Supply Chain Management Review*, vol. 4, no. 4, pp. 30-36.

Lee, HL 2002, 'Aligning supply chain strategies with product uncertainties', *California Management Review*, vol. 44, no. 3, pp. 105-119.
Lee, HL 2004, 'The triple-A supply chain', *Harvard Business Review*, vol. 82, no. 10, pp. 102-113.
Lee, HL & Billington, C 1992, 'Managing supply chain inventory: pitfalls and opportunities', *Sloan Management Review*, vol. 33, no. 3, pp. 65-73.
Lee, HL & Billington, C 1993, 'Material management in decentralized supply chains', *Operations Research*, vol. 41, no. 5, pp. 835-847.
Lee, HL, Padmanabhan, V & Whang, S 1997a, 'The bullwhip effect in supply chains', *Sloan Management Review*, vol. 38, no. 3, pp. 93-102.
Lee, HL, Padmanabhan, V & Whang, S 1997b, 'Information distortion in a supply chain: the bullwhip effect', *Management Science*, vol. 43, no. 4, pp. 546-558.
Lee, HL, So, KC & Tang, CS 2000, 'The value of information sharing in a two-level supply chain', *Management Science*, vol. 46, no. 5, pp. 626-643.
Lee, HL & Whang, S 2000, 'Information sharing in a supply chain', *International Journal of Manufacturing Technology and Management*, vol. 1, no. 1, pp. 79-93.
Lee, HL & Whang, S 2003, 'E-business and supply chain integration', *International series in Operations Research and Management Science,* vol.62, no.2, pp. 123-138.
Lee, SC, Pak, BY & Lee, HG 2003, 'Business value of B2B electronic commerce: the critical role of inter-firm collaboration', *Electronic Commerce and Applications*, vol. 2, no.4, pp. 350-361.
Lefebvre, LA, Lefebvre, É, Bendavid, Y, Wamba, SF & Boeck, H 2005, 'The potential of RFID in warehousing activities in a retail industry supply chain', *Journal on Chain and Network Science*, vol. 5, no. 2, pp. 101-110.
Lefebvre, LA, Lefebvre, É, Bendavid, Y, Wamba, SF & Boeck, H 2006, 'RFID as an enabler of B2B e-commerce and its impact of business process: a pilot study of a supply chain in the retail industry', Proceedings of the 39th Annual Hawaii International Conference on System Sciences.
Leonard-Barton, D & Deschamps, I 1988, 'Managerial influence in the implementation of new technology', *Management Science*, vol. 34, no. 10, pp. 1252-1265.
Levary, RR 2000, 'Better supply chains through information technology', *Industrial Management,* vol. 42, no. 3, pp. 24-30.
Levy, M, Powell, P & Yetton, P 2001, 'SMEs: aligning IS and the strategic context', *Journal of Information Technology*, vol. 16, no. 3, pp. 133-144.
Lewis-Beck, MS, Bryman, A & Liao, TF 2003, *The Sage encyclopedia of social science research methods,* Sage Publications, London.
Lewis, BR, Templeton, GF & Byrd, TA 2005, 'A methodology for construct development in MIS research', *European Journal of Information Systems*, vol. 14, no. 4, pp. 388-400.
Lewis, I 2001, 'Logistics and electronic commerce: an interorganizational systems perspective', *Transportation Journal*, vol. 40, no. 4, pp. 5-13.
Lewis, I & Talalayevsky, A 1997, 'Logistics and information technology: a coordination perspective', *Journal of Business Logistics*, vol. 18, no. 1, pp. 141-158.
Lewis, I & Talalayevsky, A 2004, 'Improving the interorganizational supply chain through optimization of information flows', *Journal of Enterprise Information Management*, vol. 17, no. 3, pp. 229-237.
Lewis, L 2000, 'CPFR solutions', *Progressive Grocer*, vol. 79, no. 4, pp. 28-32.
Li, G, Yang, H, Sun, L & Sohal, AS 2009, 'The impact of IT implementation on supply chain integration and performance', *International journal of Production Economics*, vol. 120, no. 1, pp. 125-138.

Li, J & Liu, L 2006, 'Supply chain coordination with quantity discount policy', *International Journal of Production Economics*, vol. 101, no. 1, pp. 89-98.
Li, M & Richard Ye, L 1999, 'Information technology and firm performance: linking with environmental, strategic and managerial contexts', *Information & Management*, vol. 35, no. 1, pp. 43-51.
Li, S & Lin, B 2006, 'Accessing information sharing and information quality in supply chain management', *Decision Support Systems*, vol. 42, no. 3, pp. 1641-1656.
Li, S, Ragu-Nathan, B, Ragu-Nathan, TS & Rao, SS 2006, 'The impact of supply chain management practices on competitive advantage and organizational performance', *The International Journal of Management Science*, vol. 34, no. 2, pp. 107-124.
Li, Z, Kumar, A & Lim, YG 2002, 'Supply chain modelling-a co-ordination approach', *Integrated Manufacturing Systems*, vol. 13, no. 8, pp. 551-561.
Liker, J & Wu, YC 2000, 'Japanese automakers, US suppliers and supply-chain superiority', *Sloan Management Review*, vol. 42, no.1, pp. 81-93.
Lim, J, Richardson, VJ & Roberts, T 2004, 'Information technology investment and firm performance: a meta-analysis', Proceeding of 37th Annual Hawaii International Conference on system sciences, USA.
Lin, C, Chow, WS, Madu, CN, Kuei, CH & Pei Yu, P 2005, 'A structural equation model of supply chain quality management and organizational performance', *International journal of Production Economics*, vol. 96, no. 3, pp. 355-365.
Lin, C, Yu-An, H & Shu-Woan, T 2007, 'A study of planning and implementation stages in electronic commerce adoption and evaluation: the case of Australian SMEs', *Contemporary Management Research*, vol. 3, no. 1, pp. 83-100.
Lin, F, Huang, S & Lin, S 2002, 'Effects of information sharing on supply chain performance in electronic commerce', *IEEE Transactions on Engineering Management*, vol. 49, no. 3, pp. 258-268.
Lind, MR & Zmud, RW 1991, 'The influence of a convergence in understanding between technology providers and users on information technology innovativeness', *Organization Science*, vol. 2, no. 2, pp. 195-217.
Lo, SM & Power, D 2010, 'An empirical investigation of the relationship between product nature and supply chain strategy', *Supply Chain Management: An International Journal*, vol 15, no. 12, pp. 139-153.
Lockamy, A & McCormack, K 2004, 'Linking SCOR planning practices to supply chain performance', *International Journal of Operations and Production Management*, vol. 24, no. 12, pp. 1192-1218.
LogicaCMG 2004, *Airbus takes RFID into the spare part supply chain,* viewed 10 Feb 2010, http://www.logicacmg.com/pSecured/admin/countries/_app/assets/airbus_casestudy-3292006.pdf.
Lonsdale, C 2008, 'Locked-ln to Supplier Dominance: On the Dangers of Asset Specificity for the Outsourcing Decision', *Institute for Supply Management*, vol. 37, no. 2, pp. 22-27.
Lopes, AB & Galletta, D 1997, 'Resource-Based Theory and a Structural Perspective of Strategy Applied to the Provision of Internet Services' Third Americans Conference of Information Systems, IN, Indianpolis.
Loudin, A 1999, 'Spicing up the food chain', *Warehousing Management*, vol. 6, no. 10, pp. 1-5.
Lucas, HC & Spitler, VK 1999, 'Technology use and performance: A field study of broker workstations', *Decision Sciences*, vol. 30, no. 2, pp. 291-312.

Lummus, RR, Duclos, LK & Vokurka, RJ 2003, 'Supply chain flexibility: Building a new model', *Global Journal of Flexible Systems Management* vol. 4, no. 4, pp. 1-13.
Lummus, RR, Krumwiede, DW & Vokurka, RJ 2001, 'The relationship of logistics to supply chain management: developing a common industry definition', *Industrial Management and Data Systems*, vol. 101, no. 8, pp. 426-431.
Lummus, RR, Vokurka, RJ & Alber, KL 1998, 'Strategic supply chain planning', *Production and Inventory Management Journal*, vol. 39, no. 3, pp. 49-58.
Luo, X & Seyedian, M 2003, 'Contextual marketing and customer-orientation strategy for e-commerce: an empirical analysis', *International Journal of Electronic Commerce*, vol. 8, no. 2, pp. 95-118.
Lusch, RF & Brown, JR 1996, 'Interdependency, contracting, and relational behavior in marketing channels', *The Journal of Marketing*, vol. 60, no. 4, pp. 19-38.
MacCallum, RC, Browne, MW & Sugawara, HM 1996, 'Power analysis and determination of sample size for covariance structure modeling', *Psychological Methods*, vol. 1, no. 2, pp. 130-149.
MacCracken, G 1996, *The long interview,* Sage, Newbury Park, California.
MacDuffie, JP, Sethuraman, K & Fisher, ML 1996, 'Product variety and manufacturing performance: evidence from the international automotive assembly plant study', *Management Science*, vol. 42, no. 3, pp. 350-369.
Maidique, MA & Hayes, RH 1984, 'The art of high-technology management', *Sloan Management Review*, vol. 26, Winter, pp. 17-29.
Malhotra, A, Gosain, S & El Sawy, OA 2005, 'Absorptive capacity configurations in supply chains: gearing for partner-enabled market knowledge creation', *MIS Quarterly*, vol. 29, no. 1, pp. 145-187.
Malhotra, NK 2009, *Marketing research: An applied orientation,* 5 edn*.,* Pearson, India.
Malone, TW & Crowston, K 1994, 'The interdisciplinary study of coordination', *ACM Computing Surveys (CSUR)*, vol. 26, no. 1, pp. 87-119.
Malone, TW & Rockart, JF 1995, 'Computers, networks and the corporation', *Scientific American*, vol. 272, no. 3, pp. 140-147.
Malone, TW, Yates, J & Benjamin, RI 1987, 'Electronic markets and electronic hierarchies', *Communication of the ACM*, vol. 30, no. 6, pp. 484-497.
Mangan, J, Lalwani, C & Gardner, B 2004, 'Combining quantitative and qualitative methodologies in logistics research', *International Journal of Physical Distribution and Logistics Management*, vol. 34, no. 7, pp. 565-578.
Marr, B & Schiuma, G 2003, 'Business performance measurement-past, present and future', *Management Decision*, vol. 41, no. 8, pp. 680-687.
Marsh, EE & White, MD 2006, 'Content analysis: a flexible methodology', *Library Trends*, vol. 55, no. 1, pp. 22-45.
Maruyama, G 1997, *Basics of structural equation modeling,* Sage Publications, Thousand Oaks, CA.
Maselli, J 2003, 'RTLS drives efficiencies at BMW', *RFID Journal*, vol. 28, November.
Mason-Jones, R, Naylor, B & Towill, DR 2000, 'Engineering the leagile supply chain', *International Journal of Agile Management Systems*, vol. 2, no. 1, pp. 54-61.
Mason-Jones, R & Towill, DR 1997, 'Information enrichment: designing the supply chain for competitive advantage', *Supply Chain Management: An International Journal*, vol. 2, no. 4, pp. 137-148.
Massetti, B & Zmud, RW 1996, 'Measuring the extent of EDI usage in complex organizations: strategies and illustrative examples', *MIS Quarterly*, vol. 20, no. 3, pp. 331-345.

Mata, FJ, Fuerst, WL & Barney, JB 1995, 'Information technology and sustained competitive advantage: A resource-based analysis', *MIS Quarterly*, vol. 19, no. 4, pp. 487-505.
Mather, H 1988, *Competitive manufacturing,* Prentice Hall Direct, Englewood Cliffs, NJ.
Matson, JB & McFarlane, DC 1999, 'Assessing the responsiveness of existing production operations', *International Journal of Operations and Production Management*, vol. 19, no. 8, pp. 765-784.
McAfee, A 2002, 'The impact of enterprise information technology adoption on operational performance: An empirical investigation', *Production and Operations Management*, vol. 11, no. 1, pp. 33-53.
McCarthy, TM & Golicic, SL 2002, 'Implementing collaborative forecasting to improve supply chain performance', *International Journal of Physical Distribution and Logistics Management*, vol. 32, no. 6, pp. 431-454.
McCutcheon, DM, Raturi, AS & Meredith, JR 1994, 'The customization-responsiveness squeeze', *Sloan Management Review*, vol. 35, no. 2, pp. 89-99.
McDermott, DR, Franzak, FJ & Little, MW 1993, 'Does marketing relate to hospital profitability?', *Journal of Health Care Marketing*, vol. 13, no. 2, pp. 18-25.
McFarlan, FW, Jordan, C & Wurmfeld, C 1984, 'Information technology changes the way you compete', *Harvard Business Review*, vol. 62, no. 3, pp. 98-103.
McIvor, R & Humphreys, P 2004, 'The implications of electronic B2B intermediaries for the buyer-supplier interface', *International journal of Operations and Production Management*, vol. 24, no. 3, pp. 241-269.
McKone-Sweet, K & Lee, Y 2009, 'Development and Analysis of a Supply Chain Strategy Taxonomy', *Journal of Supply Chain Management*, vol. 45, no. 3, pp. 3-24.
McLaren, TS, Head, MM & Yuan, Y 2004, 'Supply chain management information systems capabilities. An exploratory study of electronics manufacturers', *Information Systems and E-Business Management*, vol. 2, no. 2, pp. 207-222.
McMullan, A 1996, 'Supply chain management practices in Asian pacific today', *International Journal of Physical Distribution and Logistics*, vol. 26, no. 10, pp. 79-95.
Meadow, CT & Yuan, W 1997, 'Measuring the impact of information: defining the concepts', *Information Processing and Management*, vol. 33, no. 6, pp. 697-714.
Mehrtens, J, Cragg, PB & Mills, AM 2001, 'A model of Internet adoption by SMEs', *Information & Management*, vol. 39, no. 3, pp. 165-176.
Melville, N, Kraemer, K & Gurbaxani, V 2004, 'Information technology and organizational performance: An integrative model of IT business value', *MIS Quarterly*, vol. 28, no. 2, pp. 283-322.
Mentzer, JT, DeWitt, W, Keebler, JS, Min, S, Nix, NW, Smith, CD & Zacharia, ZG 2001, 'Defining supply chain management', *Journal of Business Logistics*, vol. 22, no. 2, pp. 1-26.
Miller, WL & Morris, L 2008, *Fourth generation R&D: Managing knowledge, technology, and innovation,* Wiley India Pvt. Ltd., NY.
Min, S, Mentzer, JT & Ladd, RT 2007, 'A market orientation in supply chain management', *Journal of the Academy of Marketing Science*, vol. 35, no. 4, pp. 507-522.
Min, S, Roath, AS, Daugherty, PJ, Genchev, SE, Chen, H, Arndt, AD & Richey, RG 2005, 'Supply chain collaboration: what's happening?', *International Journal of Logistics Management*, vol. 16, no. 2, pp. 237-256.
Miranda, SM & Saunders, CS 2003, 'The social construction of meaning: An alternative perspective on information sharing', *Information Systems Research*, vol. 14, no. 1, pp. 87-106.

Mirani, R & Lederer, AL 1998, 'An instrument for assessing the organizational benefits of IS projects', *Decision Sciences*, vol. 29, no. 4, pp. 803-838.
Mohamed, IS 2008, 'E-Commerce And Value Creation: Empirical Evidence In Malaysia Tourism Sector' EABR & TLC conference proceedings, Rothenburg, Germany.
Mohanty, RP & Deshmukh, SG 2000, 'Reengineering of a supply chain management system: a case study', *Production Planning & Control*, vol. 11, no. 1, pp. 90-104.
Mohr, JJ & Sohi, RS 1995, 'Communication flows in distribution channels: impact on assessments of communication quality and satisfaction', *Journal of Retailing*, vol. 71, no. 4, pp. 393-415.
Mollenkopf, D & Dapiran, GP 1999, 'World-class logistics: how well do Australia and New Zealand firms perform?', Council of Logistics Management Annual Conference, Toronto.
Mollenkopf, D & Dapiran, GP 2005, 'World-class logistics: Australia and New Zealand', *International Journal of Physical Distribution & Logistics Management*, vol. 35, no. 1, pp. 63-74.
Morgan, RM & Hunt, SD 1994, 'The commitment-trust theory of relationship marketing', *The Journal of Marketing*, vol. 58, no. 3, pp. 20-38.
Morse, JM 1991, 'Approaches to qualitative-quantitative methodological triangulation', *Nursing Research*, vol. 40, no. 2, pp. 120-123.
Muckstadt, JA, Murray, DH, Rappold, JA & Collins, DE 2001, 'Guidelines for collaborative supply chain system design and operation', *Information Systems Frontiers*, vol. 3, no. 4, pp. 427-453.
Mukhopadhyay, T & Kekre, S 2002, 'Strategic and operational benefits of electronic integration in B2B procurement processes', *Management Science*, vol. 48, no. 10, pp. 1301-1313.
Mukhopadhyay, T, Kekre, S & Kalathur, S 1995, 'Business value of information technology: a study of electronic data interchange', *MIS Quarterly*, vol. 19, no. 2, pp. 137-156.
Myhr, N & Spekman, RE 2005, 'Collaborative supply-chain partnerships built upon trust and electronically mediated exchange', *Journal of Business & Industrial Marketing*, vol. 20, no. 4-5, pp. 179-186.
Narasimhan, R & Das, A 1999, 'An empirical investigation of the contribution of strategic sourcing to manufacturing flexibilities and performance', *Decision Sciences*, vol. 30, no. 3, pp. 683-718.
Narasimhan, R & Jayaram, J 1998, 'Causal linkages in supply chain management: an exploratory study of North American manufacturing firms', *Decision Sciences*, vol. 29, no. 3, pp. 579-606.
Narver, JC & Slater, SF 1990, 'The effect of a market orientation on business profitability', *The Journal of Marketing*, vol. 54, no. 4, pp. 20-35.
Naude, P, Holland, C & Sudbury, M 2000, 'The Benefits of IT-Based Supply Chains-Strategic or Operational?', *Journal of Business to Business Marketing*, vol. 7, no. 1, pp. 45-67.
Neo, BS 1988, 'Factors facilitating the use of information technology for competitive advantage: An exploratory study', *Information & Management*, vol. 15, no. 4, pp. 191-201.
Neuman, WL 2005, *Social research methods: Quantitative and qualitative approaches,* Allyn and Bacon, MA.
Ngai, EWT, Cheng, TCE, Au, S & Lai, K 2007, 'Mobile commerce integrated with RFID technology in a container depot', *Decision Support Systems*, vol. 43, no. 1, pp. 62-76.

Ngai, EWT & Gunasekaran, A 2004, 'Implementation of EDI in Hong Kong: an empirical analysis', *Industrial Management and Data Systems*, vol. 104, no. 1, pp. 88-100.
Nolan, R 1994, 'Note on estimating the value of the IT asset', *Harvard Business School Note*, vol. 9, pp. 195-197.
Novack, RA, Rinehart, LM & Wells, MV 1992, 'Rethinking concept foundations in logistics management', *Journal of Business Logistics*, vol. 13, no. 2, pp. 233-268.
Olavarrieta, S & Ellinger, AE 1997, 'Resource-based theory and strategic logistics research', *International journal of Physical Distribution and Logistics Management*, vol. 27, no. 9/10, pp. 559-587.
Olson, EM, Walker Jr, OC & Ruekert, RW 1995, 'Organizing for effective new product development: the moderating role of product innovativeness', *The Journal of Marketing*, vol. 59, no. 1, pp. 48-62.
Osmonbekov, T, Bello, DC & Gilliland, DI 2009, 'The impact of e-business infusion on channel coordination, conflict and reseller performance', *Industrial Marketing Management*, vol. 38, no. 7, pp. 778-784.
Pagh, JD & Cooper, MC 1998, 'Supply chain postponement and speculation strategies: how to choose the right strategy', *Journal of Business Logistics*, vol. 19, no. 2, pp. 13-34.
Pant, S & Hsu, C 1996, 'Business on the Web: strategies and economics', *Computer Networks and ISDN Systems*, vol. 28, no. 7-11, pp. 1481-1492.
Parker, DB 1998, *Fighting computer crime: A new framework for protecting information,* John Wiley & Sons, NY.
Parlar, M & Weng, ZK 1997, 'Designing a firm's coordinated manufacturing and supply decisions with short product life cycles', *Management Science*, vol. 43, no. 10, pp. 1329-1344.
Pasternack, BA 1985, 'Optimal pricing and return policies for perishable commodities', *Marketing Science*, vol. 4, no. 2, pp. 166-176.
Patnayakuni, R, Rai, A & Seth, N 2006, 'Relational antecedents of information flow integration for supply chain coordination', *Journal of Management Information Systems*, vol. 23, no. 1, pp. 13-49.
Patterson, KA, Grimm, CM & Corsi, TM 2003, 'Adopting new technologies for supply chain management', *Transportation Research Part E: Logistics and Transportation Review*, vol. 39, no. 2, pp. 95-121.
Pavlou, PA & El Sawy, OA 2006, 'From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development', *Information Systems Research*, vol. 17, no. 3, p. 198-227.
Petersen, KJ, Handfield, RB & Ragatz, GL 2005, 'Supplier integration into new product development: coordinating product, process and supply chain design', *Journal of Operations Management*, vol. 23, no. 3-4, pp. 371-388.
Pfeffer, J 1995, 'Mortality, reproducibility, and the persistence of styles of theory', *Organization Science*, vol. 6, no. 6, pp. 681-693.
Pollock, JT & Hodgson, R 2004, *Adaptive information: improving business through semantic interoperability, grid computing, and enterprise integration,* John Wiley & Sons, NJ.
Poole, MS & Van de Ven, AH 1989, 'Using paradox to build management and organization theories', *Academy of Management Review*, vol. 14, no. 4, pp. 562-578.
Popper, KR 1961, *The logic of scientific discovery,* Science Editions, New York.
Poppo, L & Zenger, T 2002, 'Do formal contracts and relational governance function as substitutes or complements?', *Strategic Management Journal*, vol. 23, no. 8, pp. 707-725.
Porter, ME 1980, *Competitive Strategy,* Free Press, New York.

Porter, ME 1985, 'Technology and competitive advantage', *Journal of Business Strategy*, vol. 5, no. 3, pp. 60-78.
Porter, ME 1998, *Competitive advantage,* Free Press, New York.
Porter, ME & Millar, VE 1985, 'How information gives you competitive advantage', *Harvard Business Review*, vol. 63, no. 4, pp. 149-160.
Powell, TC & Dent-Micallef, A 1997, 'Information technology as competitive advantage: the role of human, business, and technology resources', *Strategic Management Journal*, vol. 18, no. 5, pp. 375-405.
Power, D 2004, 'The comparative importance of human resource management practices in the context of business to business (B2B) electronic commerce', *Information Technology and People*, vol. 17, no. 4, pp. 380-406.
Power, D 2005, 'Determinants of business-to business e-commerce implementation and performance: a structural model ', *An international Journal of Supply Chain Management*, vol. 10, no. 2, pp. 96-113.
Power, D & Simon, A 2004, 'Adoption and diffusion in technology implementation: a supply chain study', *International Journal of Operations and Production Management*, vol. 24, no. 6, pp. 566-587.
Power, D & Singh, P 2007, 'The e-integration dilemma: the linkages between internet technology application, trading partner relationships and structural change', *Journal of Operations Management*, vol. 25, no. 6, pp. 1292-1310.
Prahalad, CK & Hamel, G 1990, 'The core competence of the organization', *Harvard Business Review*, vol. 68, no. 3, pp. 79-91.
Prahalad, CK & Krishnan, MS 1999, 'The new meaning of quality in the information age', *Harvard Business Review*, vol. 77, no. 5, pp. 109-119.
Premkumar, G & King, WR 1994, 'The evaluation of strategic information system planning', *Information & Management*, vol. 26, no. 6, pp. 327-340.
Qi, Y, Boyer, KK & Zhao, X 2009, 'Supply Chain Strategy, Product Characteristics, and Performance Impact: Evidence from Chinese Manufacturers', *Decision Sciences*, vol. 40, no. 4, pp. 667-695.
Quinn, JB 1987, *Technological innovation, entrepreneurship, and strategy,* Oxford University Press, USA.
Quinn, JB 1992, *Intelligent enterprise: A knowledge and service based paradigm for industry,* Free Press, NY.
Rackoff, N, Wiseman, C & Ullrich, WA 1985, 'Information systems for competitive advantage: implementation of a planning process', *MIS Quarterly*, vol. 9, no. 4, pp. 285-294.
Raghunathan, B & Raghunathan, TS 1994, 'Research Report-Adaptation of a Planning System Success Model to Information Systems Planning', *Information Systems Research*, vol. 5, no. 3, p. 326-340.
Raghunathan, S & Yeh, AB 2001, 'Beyond EDI: impact of continuos replenishment program (CRP) between a manufacturer and its retailers', *Information System Research*, vol. 12, no. 4, pp. 406-419.
Rai, A, Patnayakuni, R & Patnayakuni, N 1996, 'Refocusing where and how IT value is realized: An empirical investigation', *Omega*, vol. 24, no. 4, pp. 399-412.
Rai, A, Patnayakuni, R & Seth, N 2006, 'Firm performance impacts of digitally enabled supply chain integration capabilities', *MIS Quarterly*, vol. 30, no. 2, pp. 225-246.
Ramaseshan, B 1997, 'Attitude towards use of electronic data interchange in industrial buying: some Australian evidence, *Supply Chain Management: An International Journal*, vol. 2, no. 4, pp. 149-157.

Ramdas, K 2003, 'Managing product variety: An integrative review and research directions', *Production and Operations Management*, vol. 12, no. 1, pp. 79-101.
Ramdas, K & Spekman, RE 2000, 'Chain or shackles: understanding what drives supply-chain performance', *Interfaces*, vol. 30, no. 4, pp. 3-21.
Randall, T & Ulrich, K 2001, 'Product variety, supply chain structure, and firm performance: analysis of the US bicycle industry', *Management Science*, vol. 47, no. 12, pp. 1588-1604.
Randall, TR, Morgan, RM & Morton, AR 2003, 'Efficient versus responsive supply chain choice: an empirical examination of influential factors', *Journal of Product Innovation Management*, vol. 20, no. 6, pp. 430-443.
Ravichandran, T & Lertwongsatien, C 2005, 'Effect of information systems resources and capabilities on firm performance: A resource-based perspective', *Journal of Management Information Systems*, vol. 21, no. 4, pp. 237-276.
Ravichandran, T & Rai, A 2000, 'Quality management in systems development: an organizational system perspective', *MIS Quarterly*, vol. 24, no. 3, pp. 381-415.
Ray, G, Barney, JB & Muhanna, WA 2004, 'Capabilities, business processes, and competitive advantage: choosing the dependent variable in empirical tests of the resource-based view', *Strategic Management Journal*, vol. 25, no. 1, pp. 23-37.
Ray, G, Muhanna, WA & Barney, JB 2005, 'Information technology and the performance of the customer service process: A resource-based analysis', *Management Information Systems Quarterly*, vol. 29, no. 4, pp. 625-653.
Raykov, T & Marcoulides, GA 2006, *A first course in structural equation modeling,* Lawrence Erlbaum, NJ.
Reich, BH & Benbasat, I 2000, 'Factors that influence the social dimension of alignment between business and information technology objectives', *MIS Quarterly*, vol. 24, no. 1, pp. 81-113.
Reichhart, A & Holweg, M 2007, 'Creating the customer-responsive supply chain: a reconciliation of concepts', *International Journal of Operations & Production Management*, vol. 27, no. 11, pp. 1144-1172.
Reutterer, T & Kotzab, HW 2000, 'The use of conjoint-analysis for measuring preferences in supply chain design', *Industrial Marketing Management*, vol. 29, no. 1, pp. 27-35.
Reynolds, PD 1971, *A primer in theory construction,* Bobbs-Merrill Educational Publishing, IN.
Ricker, J, Munro, D & Hopeman, D 2001, *XML and EDI: Peaceful Co-Existence*, viewed 16 July 2009, http://www1.qedi.co.za/phisc/xml/docs/XMLSolutions_Peaceful_Co-Existence.pdf.
Rindfleisch, A & Heide, JB 1997, 'Transaction cost analysis: past, present, and future applications', *The Journal of Marketing*, vol. 61, no. 4, pp. 30-54.
Roach, SS 1991, *Pitfalls on the new assembly line: Can services learn from manufacturing,* OECD Publishing, NY.
Roberts, B & Mackay, M 1998, 'IT supporting supplier relationships: the role of electronic commerce', *European journal of Purchasing and Supply Management*, vol. 4, no. 2-3, pp. 175-184.
Roberts, CM 2006, 'Radio frequency identification (RFID)', *Computers & Security*, vol. 25, no. 1, pp. 18-26.
Rockart, JF, Earl, MJ & Ross, JW 1996, 'Eight imperatives for the new IT organization', *Sloan Management Review*, vol. 38, no. 1, pp. 43-55.
Rockart, JF & Short, JE 1989, 'IT in the 1990s: Managing organizational interdependence', *Sloan management review*, vol. 30, no. 2, pp. 7-17.

Rogers, DS, Daugherty, PJ & Stank, TP 1993, 'Enhancing Service Responsiveness', *Logistics Information Management*, vol. 6, no. 3, pp. 27-32.
Rosenberg, N 2000, *Schumpeter and the endogeneity of technology: some American perspectives,* Routledge, NY.
Rosenzweig, ED, Roth, AV & Dean Jr, JW 2003, 'The influence of an integration strategy on competitive capabilities and business performance: an exploratory study of consumer products manufacturers', *Journal of Operations Management*, vol. 21, no. 4, pp. 437-456.
Ross, JW, Beath, CM & Goodhue, DL 1998, 'Develop long-term competitiveness through IT assets', *IEEE Engineering Management Review*, vol. 26, no. 2, pp. 37-47.
Rumelt, RP 1997, *Towards a strategic theory of the firm,* Prentice-Hall, Englewood Cliffs, NJ.
Rumelt, RP 2005, *Theory, Strategy, and Entrepreneurship,* Springer, NY.
Russo, MV & Fouts, PA 1997, 'A resource-based perspective on corporate environmental performance and profitability', *The Academy of Management Journal*, vol. 40, no. 3, pp. 534-559.
Sabherwal, R & King, WR 1995, 'An empirical taxonomy of the decision-making processes concerning strategic applications of information systems', *Journal of Management Information Systems*, vol. 11, no. 4, pp. 177-214.
Sachan, A & Datta, S 2005, 'Review of supply chain management and logistics research', *International Journal of Physical Distribution & Logistics Management*, vol. 35, no. 9, pp. 664-705.
Sahin, F & Robinson, EP 2002, 'Flow coordination and information sharing in supply chains: review, implications, and directions for future research', *Decision Science,* vol. 33, no. 4, pp. 505-536.
Sahin, F & Robinson, EP 2005, 'Information sharing and coordination in make-to-order supply chains', *Journal of Operations Management*, vol. 23, no. 6, pp. 579-598.
Salmeron, JL & Bueno, S 2006, 'An information technologies and information systems industry-based classification in small and medium-sized enterprises: an institutional view', *European Journal of Operational Research*, vol. 173, no. 3, pp. 1012-1025.
Salo, J 2006, *Business relationship digitalization: A case study from the steel processing industry*, thesis, Faculty of Economics and Business Administration, Department of Marketing, University of Ouluensis.
Salo, J & Tähtinen, J 2005, 'Retailer use of permission-based mobile advertising', *Advances In Electronic Marketing*, Idea Publishing Group, PA.
Sanders, N. R. (1992). 'Merging EDI with JIT: the impact on US manufacturing' *Journal of Applied Business Research,* vol. 8, no. 2, pp. 133-137.
Sanders, NR 2005, 'IT alignment in supply chain relationships: a study of supplier benefits', *Journal of Supply Chain Management*, vol. 41, no. 2, pp. 4-13.
Sanders, NR 2007, 'An empirical study of the impact of e-business technologies on organizational collaboration and performance', *Journal of Operations Management* vol. 25, no. 6, pp. 1332-1347.
Sanders, NR 2008, 'Pattern of information technology use: the impact on buyer-supplier coordination and performance', *Journal of Operations Management*, vol. 26, no. 3, pp. 349-367.
Sanders, NR & Premus, R 2002, 'IT applications in supply chain organizations: a link between competitive priorities and organizational benefits', *Journal of Business Logistics*, vol. 23, no. 1, pp. 65-84.

Sanders, NR & Premus, R 2005, 'Modelling the relationship between firm IT capability, collaboration, and performance', *Journal of Business Logistics*, vol. 26, no. 1, pp. 1-23.
Saunders, M, Thornhill, A & Lewis, P 2009, *Research methods for business students,* Financial Times/Prentice Hall, London.
Saraf, N., Langdon, C. S. & Gosain, S 2007, 'IS application capabilities and relational value in interfirm partnerships', *Information Systems Research*, vol. 18, no. 3, pp. 320-339.
Sawhney, M & Zabin, J 2001, *The seven steps to nirvana: Strategic insights into ebusiness transformation,* McGraw-Hill, Inc. New York.
Schendel, D 1994, 'Introduction to Competitive Organizational Behavior: Toward an Organizationally-Based Theory of Competitive Advantage', *Strategic Management Journal*, vol. 15, no. 8, pp. 1-4.
Schulze, WS 1992, 'The two resource-based models of the firm: Definitions and implications for research' Academy of Management Best Paper Proceedings, pp.37-42.
Sebastian, J & Lambert, DM 2003, 'Internet-enabled coordination in the supply chain', *Industrial Marketing Management*, vol. 32, no. 2, pp. 251-263.
Seggie, SH, Kim, D & Cavusgil, ST 2006, 'Do supply chain IT alignment and supply chain interfirm system integration impact upon brand equity and firm performance?', *Journal of Business Research*, vol. 59, no. 8, pp. 887-895.
Seifert, D 2003, *Collaborative planning, forecasting, and replenishment: how to create a supply chain advantage,* Galileo Press, GmbH, Kevelaer.
Sekaran, U 2006, *Research methods for business,* Wiley India Pvt. Ltd., India.
Selldin, E & Olhager, J 2007, 'Linking products with supply chains: testing Fisher's model', *Supply Chain Management: An International Journal*, vol. 12, no. 1, pp. 42-51.
Sethi, V & King, WR 1994, 'Development of measures to assess the extent to which an information technology application provides competitive advantage', *Management Science*, vol. 40, no. 12, pp. 1601-1627.
Setia, P, Vickery, S, Droge, C & Sambamurthy, V 2007, *Complementarities between Supply Chain Processes and Information Technologies: The Impacts on Performance of Manufacturing Firms,* Viewed 21 June 2010, http://www.stern.nyu.edu/ciio/WorkOnline/IS20052006/033006.pdf.
Seuring, S & Müller, M 2008, 'From a literature review to a conceptual framework for sustainable supply chain management', *Journal of Cleaner Production*, vol. 16, no. 15, pp. 1699-1710.
Seuring, SA 2008, 'Assessing the rigor of case study research in supply chain management', *Supply Chain Management: An International Journal*, vol. 13, no. 2, pp. 128-137.
Sezen, B 2008, 'Relative effects of design, integration and information sharing on supply chain performance', *Supply Chain Management: An International Journal*, vol. 13, no. 3, pp. 233-240.
Sheffi, Y 2004, 'RFID and the innovation cycle', *International Journal of Logistics Management*, vol. 15, no. 1, pp. 1-10.
Sherer, SA 2005, 'From supply-chain management to value network advocacy: implications for e-supply chains', *Supply Chain Management: An International Journal*, vol. 10, no. 2, pp. 77-83.
Sherman, RJ 1998, 'Collaborative planning, forecasting & replenishment (CPFR): Realizing the promise of efficient consumer response through collaborative technology', *Journal of Marketing Theory and Practice*, vol. 6, no. 4, pp. 6-9.
Shin, N 1999, 'Does information technology improve coordination? An empirical analysis', *Logistics information management*, vol. 12, no. 1/2, pp. 138-44.

Shingo, S & Dillon, AP 1989, *A study of the Toyota production system from an industrial engineering viewpoint,* Productivity Press, New York.
Shore, B & Venkatachalam, AR 2003, 'Evaluating the information sharing capabilities of supply chain partners', *International Journal of Physical Distribution & Logistics Management*, vol. 33, no. 9, pp. 804-824.
Siemieniuch, CE, Waddell, FN & Sinclair, MA 1999, 'The role of partnership in supply chain management for fast-moving consumer goods: a case study', *International Journal of Logistics Research and Applications*, vol. 2, no. 1, pp. 87-101.
Silveira, GJC & Cagliano, R 2006, 'The relationship between interorganizational information systems and operations performance', *International Journal of Operations & Production Management*, vol. 26, no. 3, pp. 232-253.
Silverman, D 2006, *Interpreting qualitative data: Methods for analyzing talk, text, and interaction,* Sage Publications, CA.
Simatupang, TM, Sandroto, IV & Lubis, SBH 2004, 'Supply chain coordination in a fashion firm', *Supply Chain Management: An International Journal*, vol. 9, no. 3, pp. 256-268.
Simatupang, TM, Wright, AC & Sridharan, R 2002, 'The knowledge of coordination for supply chain integration', *Business Process Management Journal*, vol. 8, no. 3, pp. 289-308.
Simchi-Levi, E & Kaminsky, P 2003, *Designing and managing the supply chain: concepts, strategies, and case studies,* Irwin/McGraw-Hill, NY.
Simon, HA 1950, 'Administrative behavior', Macmillan, NY.
Sinclair, MA, Siemieniuch, CE, Cooper, KA & Waddell, N 1995, 'A discussion of simultaneous engineering and the manufacturing supply chain, from an ergonomics perspective', *International Journal of Industrial Ergonomics*, vol. 16, no. 4-6, pp. 263-281.
Sinkula, JM, Baker, WE & Noordewier, T 1997, 'A framework for market-based organizational learning: linking values, knowledge, and behavior', *Journal of the Academy of Marketing Science*, vol. 25, no. 4, pp. 305-318.
Sircar, S, Turnbow, JL & Bordoloi, B 2000, 'A framework for assessing the relationship between information technology investments and firm performance', *Journal of Management Information Systems*, vol. 16, no. 4, pp. 69-97.
Skjoett-Larsen, T, Thernøe, C & Andresen, C 2003, 'Supply chain collaboration', *International Journal of Physical Distribution & Logistics Management*, vol. 33, no. 6, pp. 531-550.
Slack, N, Chambers, S & Johnston, R 2004, *Operations Management,* Pearson Education, NY.
Slater, SF & Narver, JC 1994, 'Market orientation, customer value, and superior performance', *Business Horizons*, vol. 37, no. 2, pp. 22-28.
Small, CT & Sage, AP 2006, 'Knowledge management and knowledge sharing: A review', *Information, Knowledge, Systems Management*, vol. 5, no. 3, pp. 153-169.
Smaros, J, Lehtonen, JM, Appelqvist, P & Holmstrom, J 2003, 'The impact of increasing demand visibility on production and inventory control efficiency', *International journal of Physical Distribution and Logistics Management*, vol. 33, no. 4, pp. 336-354.
Smith, AD 2005, 'Exploring radio frequency identification technology and its impact on business systems', *Information Management & Computer Security*, vol. 13, no. 1, pp. 16-28.

Soh, C & Markus, ML 1995, 'How IT creates business value: a process theory synthesis' 16th International Conference on Information Systems, Society for Information Management, pp.29-42.
Soliman, F & Youssef, M 2001, 'The impact of some recent developments in e-business on the management of next generation manufacturing', *International journal of Operations and Production Management*, vol. 21, no. 5/6, pp. 538-564.
Spengler, JJ 1950, 'Vertical integration and antitrust policy', *The Journal of Political Economy*, vol. 58, no. 4, pp. 347-352.
Sriram, V & Stump, R 2004, 'Information technology investments in purchasing: an empirical investigation of communications, relationship and performance outcomes', *Omega*, vol. 32, no. 1, pp. 41-55.
Srivastava, B 2004, 'Radio frequency ID technology: The next revolution in SCM', *Business Horizons*, vol. 47, no. 6, pp. 60-68.
Srivastava, RK, Shervani, TA & Fahey, L 1999, 'Marketing, business processes, and shareholder value: an organizationally embedded view of marketing activities and the discipline of marketing', *The Journal of Marketing*, vol. 63, Special Issue, pp. 168-179.
Stadtler, H 2008, *Supply chain management and advanced planning: concepts, models, software, and case studies,* Springer Verlag, Berlin.
Stalk, G, Evans, P & Shulman, LE 1992, 'Competing on Capabilities: The New Rules of Corporate Strategy', *Harvard Business Review*, vol. 70, no. 2, pp. 54-65.
Stank, TP & Crum, MR 1999, 'Benefits of interfirm coordination in food industry supply chains', *Journal of Business Logistics*, vol. 20, no. 2, pp. 21-41.
Starr, MK 1965, 'Modular production–a new concept', *Harvard Business Review*, vol. 43, no. 6, pp. 131-142.
Steinfield, C, Kraut, R & Plummer, A 1995, 'The impact of interorganizational networks on buyer-seller relationships', *Journal of Computer-Mediated Communication*, vol. 1, no. 3, pp.1-15.
Stephens, M & Ramos, H 2003, 'Who Moved My ERP Solution', *Journal of Industrial Technology*, vol. 19, no. 1, pp. 1-6.
Stevens, GC 1989, 'Integrating the supply chain', *International Journal of Physical Distribution and Materials Management*, vol. 19, no. 8, pp. 3-8.
Stock, JR, Boyer, SL & Harmon, T 2010, Research opportunities in supply chain management, *Journal of the Academy of Marketing Science*, vol. 38, no.1, pp. 32-41
Storey, J, Emberson, C & Reade, D 2005, 'The barriers to customer responsive supply chain management', *International Journal of Operations & Production Management*, vol. 25, no. 3, pp. 242-260.
Stratopoulos, T & Dehning, B 2000, 'Does successful investment in information technology solve the productivity paradox?', *Information & Management*, vol. 38, no. 2, pp. 103-117.
Straub, D, Boudreau, MC & Gefen, D 2004, 'Validation guidelines for IS positivist research', *Communications of the Association for Information Systems*, vol. 13, no. 24, pp. 380-427.
Strauss, J & Frost, R 2008, *E-marketing,* Prentice Hall, Upper Saddle River, NJ.
Strout, E 1971, 'The activities and education of systems analyst', *Journal of Systems Management*, vol. 22, no. 1, pp. 37-40.
Suarez, FF, Cusumano, MA & Fine, CH 1995, 'An empirical study of flexibility in manufacturing', *Sloan Management Review*, vol. 37, no. 1, pp. 25-32.

Subramani, M 2004, 'How do suppliers benefit from information technology use in supply chain relationships', *MIS Quarterly*, vol. 28, no. 1, pp. 45-73.
Sullivan, L 2004, 'European retailers accelerate RFID plans', *Information Week*, January.
Swafford, PM, Ghosh, S & Murthy, N 2008, 'Achieving supply chain agility through IT integration and flexibility', *International Journal of Production Economics*, vol. 116, no. 2, pp. 288-297.
Swafford, PM, Ghosh, S & Murthy, NN 2006, 'A framework for assessing value chain agility', *International Journal of Operations & Production Management*, vol. 26, no. 2, pp. 118-140.
Swaminathan, JM, Smith, SF & Sadeh, NM 1994, 'Modeling the dynamics of supply chains', Proceedings of AAAI-SIGMAN Workshop on Intelligent Manufacturing Systems, Seattle, WA, pp.113-122.
Swartz, J 2000, 'Changing retail trends, new technologies, and the supply chain', *Technology in Society*, vol. 22, no. 1, pp. 123-132.
Tabachnick, BG & Fidell, LS 2006, *Using multivariate statistics,* 5th edn.*,* Pearson/Allyn and Bacon, Boston.
Tan, KC 2001, 'A framework of supply chain management literature', *European journal of Purchasing and Supply Management*, vol. 7, no. 1, pp. 39-48.
Tan, KC, Kannan, VR & Ghosh, S 1999, 'Supply chain management: an empirical study of its impact on performance', *International journal of Operations and Production Management*, vol. 19, no. 10, pp. 1034-1052.
Tan, KC, Kannan, VR & Handfield, RB 1998, 'Supply chain management: supplier performance and firm performance', *International journal of Purchasing and Material Management,* vol. 34, no. 3, pp. 2-9.
Tangen, S 2003, 'An overview of frequently used performance measures', *Work study*, vol. 52, no. 7, pp. 347-354.
Tashakkori, A & Teddlie, C 2003, *Research design: Qualitative, quantitative, and mixed methods approaches,* Sage, Thousand Oaks, CA.
Teece, DJ, Pisano, G & Shuen, A 1997, 'Dynamic capabilities and strategic management', *Strategic Management Journal*, vol. 18, no. 7, pp. 509-533.
Teo, HH, Wei, KK & Benbasat, I 2003, 'Predicting intention to adopt interorganizational linkages: An institutional perspective', *MIS Quarterly*, vol. 27, no. 1, pp. 19-49.
Thatcher, ME & Oliver, JR 2001, 'The impact of technology investments on a firm's production efficiency, product quality, and productivity', *Journal of Management Information Systems*, vol. 18, no. 2, pp. 17-45.
Thomson, JD 1967, *Organizations in action,* McGraw-Hill, New York.
Todd, PA, McKeen, JD & Gallupe, RB 1995, 'The evolution of IS job skills: a content analysis of IS job advertisements from 1970 to 1990', *MIS Quarterly*, vol. 19, no. 1, pp. 1-27.
Towill, D & Christopher, M 2003, 'The supply chain strategy conundrum: to be lean or agile or to be lean and agile', *Supply Chain Practice*, vol. 5, no. 2, pp. 30-45.
Tracey, M, Lim, J-S & Vonderembse, MA 2005, 'The impact of supply chain management capabilities on business performance', *An international Journal of Supply Chain Management*, vol. 10, no. 3, pp. 179-191.
Trauth, EM, Farwell, DW & Lee, D 1993, 'The IS expectation gap: Industry expectations versus academic preparation', *MIS Quarterly*, vol. 17, no. 3, pp. 293-307.
Truman, GE 2000, 'Integration in electronic exchange environments', *Journal of Management Information Systems*, vol. 17, no. 1, pp. 209-244.

Tsay, AA 1999, 'The quantity flexibility contract and supplier-customer incentives', *Management Science*, vol. 45, no. 10, pp. 1339-1358.
Tsay, AA & Agrawal, N 2000, 'Channel dynamics under price and service competition', *Manufacturing & Service Operations Management*, vol. 2, no. 4, pp. 372-391.
Tunc, EA & Gupta, JND 1993, 'Is time a competitive weapon among manufacturing firms?', *International journal of Operations and Production Management*, vol. 13, no. 3, pp. 4-12.
Turban, E, Lee, J, King, D & Chung, HM 2000, *Electronic commerce: a managerial perspective,* Prentice-Hall, Inc. Upper Saddle River, NJ.
Turban, E, Leidner, D, Mclean, E & Wetherbe, J 2008, *Information technology for management-transforming organizations in the digital economy,* John Wiley & Sons, NY.
Tuunainen, VK 1995, *Interorganizational Information Systems in Small and Medium Sized Enterprises-The Evolution of EDI among Subcontractors in the Automotive Industry,* thesis, Helsinki School of Economics and Business Administration, Department of Management, Helsinki, Finland.
Tuunainen, VK 1998, 'Opportunities of effective integration of EDI for small businesses in the automotive industry', *Information & Management*, vol. 34, no. 6, pp. 361-375.
Tyndall, GR, Partsch, W, Kamauff, JW & Gopal, C 1998, *Supercharging supply chains: New ways to increase value through global operational excellence,* John Wiley & Sons, NY.
Ullman, JB & Bentler, PM 2004, 'Structural equation modeling', *Handbook of data analysis*, Sage, CA, pp. 431-458.
Upton, DM 1995, 'Flexibility as process mobility: the management of plant capabilities for quick response manufacturing', *Journal of Operations Management*, vol. 12, no. 3-4, pp. 205-224.
Uusipaavalniemi, S 2009, 'Framework for analysing and developing information integration-A study on steel industry maintenance service supply chain', thesis, Faculty of Technology of the University of Oulu, University of Oulu.
Uusipaavalniemi, S & Juga, J 2009, 'Information integration in maintenance services', *International Journal of Productivity and Performance Management*, vol. 58, no. 1, pp. 92-110.
Vakharia, AJ 2002, 'E-business and supply chain management', *Decision Sciences*, vol. 33, no. 4, pp. 495-504.
Van de Ven, AH 1989, 'Nothing is quite so practical as a good theory', *The Academy of Management Review*, vol. 14, no. 4, pp. 486-489.
Van Hoek, R 2001, 'E-supply chains–virtually non-existing', *Supply Chain Management: An International Journal*, vol. 6, no. 1, pp. 21-28.
Van Hoek, RI, Harrison, A & Christopher, M 2001, 'Measuring agile capabilities in the supply chain', *International journal of Operations and Production Management*, vol. 21, no. 1/2, pp. 126-147.
Van Maanen, J 1995, 'Fear and loathing in organization studies', *Organization science*, vol. 6, no. 6, pp. 687-692.
Venkatraman, N 1994, 'IT-enabled business transformation: from automation to business scope redefinition', *Sloan Management Review*, vol. 35, no. 2, pp. 73-87.
Venkatraman, N & Zaheer, A 1994, *Electronic integration and strategic advantage: a quasi-experimental study in the insurance industry,* Oxford University Press.

Vergin, RC & Barr, K 1999, 'Building competitiveness in grocery supply through continuous replenishment planning: insights from the field', *Industrial Marketing Management*, vol. 28, no. 2, pp. 145-153.
Verity, J 1997, 'Collaborative forecasting: vision quest', *Computerworld*, vol. 31, no. 45, pp. 12-14.
Verity, JW 1996, 'Invoice? What's an invoice', *Business Week*, vol. 10, June, pp. 110-112.
Vickery, SK, Jayaram, J, Droge, C & Calantone, R 2003, 'The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships', *Journal of operations management*, vol. 21, no. 5, pp. 523-539.
Vijayasarathy, LR & Robey, D 1997, 'The effect of EDI on market channel relationships in retailing', *Information & Management*, vol. 33, no. 2, pp. 73-86.
Vlosky, RP, Fontenot, R & Blalock, L 2000, 'Extranets: impacts on business practices and relationships', *Journal of Business & Industrial Marketing*, vol. 15, no. 6, pp. 438-457.
Vlosky, RP, Smith, PM & Wilson, DT 1994, 'Electronic data interchange implementation strategies', *Journal of Business and Industrial Marketing*, vol. 9, no. 4, pp. 5-18.
Voss, C, Tsikriktsis, N & Frohlich, M 2002, 'Case research in operations management', *International journal of Operations and Production Management*, vol. 22, no. 2, pp. 195-219.
Wacker, JG 1998, 'A definition of theory: research guidelines for different theory-building research methods in operations management', *Journal of operations management*, vol. 16, no. 4, pp. 361-385.
Walker, G & Weber, D 1987, 'Supplier competition, uncertainty, and make-or-buy decisions', *Academy of Management Journal*, vol. 30, no. 3, pp. 589-596.
Walker, H & Harland, C 2008, 'E-procurement in the United Nations- influences, issues and impact', *International journal of Operations and Production Management*, vol. 28, no. 9, pp. 831-857.
Waller, M, Johnson, ME & Davis, T 1999, 'Vendor-managed inventory in the retail supply chain', *Journal of Business Logistics*, vol. 20, no. 1, pp. 183-203.
Walton, SV & Gupta, JND 1999, 'Electronic data interchange for process change in an integrated supply chain', *International Journal of Operations & Production Management*, vol. 19, no. 4, pp. 372-88.
Wamba, SF, Lefebvre, LA, Bendavid, Y & Lefebvre, E 2008, 'Exploring the impact of RFID technology and the EPC network on mobile B2B ecommerce: a case study in the retail industry', *International journal of Production Economics*, vol. 112, no. 2, pp. 614-629.
Wang, ETC, Tai, JCF & Wei, H-L 2006, 'A virtual integration theory of improved supply-chain performance', *Journal of Management Information Systems*, vol. 23, no. 2, pp. 41-64.
Watson, HJ, Young, D, Miranda, S, Robichaux, B & Seerley, R 1990, 'Requisite skills for new MIS hires', *ACM SIGMIS Database*, vol. 21, no. 1, pp. 20-29.
Webb, B & Schlemmer, F 2008, *Information technology and competitive advantage in small firms,* Taylor & Francis, NY.
Weber, RP 1996, *Basic content analysis,* Sage Publications, CA.
Wena, HJ, Yenb, DC & Linc, B 1998, 'Methods for measuring information technology investment payoff', *Human Systems Management*, vol. 17, no. 2, pp. 145-153.
Weston, R & Gore Jr, PA 2006, 'A brief guide to structural equation modeling', *The Counseling Psychologist*, vol. 34, no. 5, pp. 719-751.

Whang, S 1995, 'Coordination in operations: a taxonomy', *Journal of Operations Management*, vol. 12, no. 3-4, pp. 413-422.
White, A, Johnson, M & Wilson, H 2008, 'RFID in the supply chain: lessons from European early adopters', *International journal of Physical Distribution and Logistics Management*, vol. 38, no. 2, pp. 88-107.
White, MD & Marsh, EE 2006, 'Content Analysis: A Flexible Methodology', *Library Trends*, vol. 55, no. 1, pp. 22-45.
Whiteoak, P 1999, 'The realities of quick response in the grocery sector: a supplier viewpoint', *International journal of Physical Distribution and Logistics Management*, vol. 29, no. 7/8, pp. 508-520.
Wigand, RT & Benjamin, RI 1995, 'Electronic commerce: effects on electronic markets', *Journal of Computer Mediated Communication*, vol. 1, no. 3, pp. 28-32.
Williams, LR, Nibbs, A, Irby, D & Finely, T (1997), 'Logistics Integration: The Effect of Information Technology, Team Composition, and Corporate Competitive Positioning', *Journal of Business Logistics*, vol. 18, no. 2, pp. 31-42.
Williams, LR, Esper, TL & Ozment, J 2002, 'The electronic supply chain', *International Journal of Physical Distribution & Logistics Management*, vol. 32, no. 8, pp. 703-719.
Williamson, OE 1975, *Markets and hierarchies, analysis and antitrust implications,* Free Press, NY.
Williamson, OE 1979, 'Transaction-cost economics: the governance of contractual relations', *The journal of Law and Economics*, vol. 22, no. 2, pp. 233-261.
Williamson, OE 1985, *The Economic Intstitutions of Capitalism: Firms, Markets, Relational contracting,* Free Pr, NY.
Williamson, OE 1991, 'Comparative economic organization: The analysis of discrete structural alternatives', *Administrative Science Quarterly*, vol. 36, no. 2, pp. 269-296.
Williamson, OE 1996, *The mechanisms of governance,* Oxford University Press, USA.
Williamson, OE, Schmalensee, R & Willig, R 1989, *Handbook of industrial organization,* Elsevier Science Publishers, BV.
Wilson, DT & Vlosky, RP 1998, 'Interorganizational information system technology and buyer-seller relationships', *Journal of Business & Industrial Marketing*, vol. 13, no. 3, pp. 215-234.
Winter, SG & Nelson, RR 1982, *An evolutionary theory of economic change,* Cambridge, MA.
Wognum, PM, Fisscher, OAM & Weenink, SAJ 2002, 'Balanced relationships: management of client–supplier relationships in product development', *Technovation*, vol. 22, no. 6, pp. 341-351.
Wood, A 1993, 'Efficient consumer response', *Logistics Information Management*, vol. 6, no. 4, pp. 38-40.
Wu, F, Mahajan, V & Balasubramanian, S 2003, 'An analysis of e-business adoption and its impact on business performance', *Journal of the Academy of Marketing Science*, vol. 31, no. 4, pp. 425-447.
Wu, F, Yeniyurt, S, Kim, D & Cavusgil, ST 2006, 'The impact of information technology on supply chain capabilities and firm performance: a resource-based view', *Industrial Marketing Management*, vol. 35, no. 4, pp. 493-504.
Yamin, M & Sinkovics, RR 2006, 'Online internationalisation, psychic distance reduction and the virtuality trap', *International Business Review*, vol. 15, no. 4, pp. 339-360.
Yang, B & Burns, N 2003, 'Implications of postponement for the supply chain', *International journal of Production Research*, vol. 41, no. 9, pp. 2075-2090.

Yang, G & Jarvenpaa, SL 2006, 'Trust and radio frequency identification (RFID) adoption within an alliance', Proceedings of the 38th Annual Hawaii International Conference on System Sciences, Austin.
Yao, Y, Palmer, J & Dresner, M 2007, 'An interorganizational perspective on the use of electronically-enabled supply chains', *Decision Support Systems*, vol. 43, no. 3, pp. 884-896.
Yasin, MM, Czuchry, AJ, Gonzales, M & Bayes, PE 2006, 'E-commerce implementation challenges: small to medium-sized versus large organisations', *International Journal of Business Information Systems*, vol. 1, no. 3, pp. 256-275.
Yuchtman, E & Seashore, SE 1967, 'A system resource approach to organizational effectiveness', *American Sociological Review*, vol. 32, no. 6, pp. 891-903.
Yusuf, YY, Gunasekaran, A, Adeleye, EO & Sivayoganathan, K 2004, 'Agile supply chain capabilities: Determinants of competitive objectives', *European Journal of Operational Research*, vol. 159, no. 2, pp. 379-392.
Zhang, C & Dhaliwal, J 2009, 'An investigation of resource-based and institutional theoretic factors in technology adoption for operations and supply chain management', *International journal of Production Economics*, vol. 120, no. 1, pp. 252-269.
Zhang, MJ 2007, 'Assessing the performance impacts of information systems from the resource-based perspective: an empirical test of the indirect effect of IS', *Journal of Business Strategies*, vol. 24, no. 2, pp. 141-164.
Zhu, K & Kraemer, KL 2003, 'E-commerce metrics for net-enhanced organizations: Assessing the value of e-commerce to firm performance in the manufacturing sector', *Information Systems Research*, vol. 13, no. 3, pp. 275-295.
Zhu, K & Kraemer, KL 2005, 'Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry', *Information Systems Research*, vol. 16, no. 1, pp. 61-84.
Zhu, K, Kraemer, KL & Dedrick, J 2004, 'Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry', *Journal of Management Information Systems*, vol. 21, no. 1, pp. 17-54.
Zhu, K, Kraemer, KL, Gurbaxani, V & Xu, SX 2006, 'Migration to open-standard interorganizational systems: network effects, switching costs, and path dependency', *Management Information Systems Quarterly*, vol. 30, no. 3, pp. 515-539.
Zikmund, WG 2003, *Business research methods,* 7th edn., Thomson, Cincinnati, OH.
Zipkin, PH 2000, *Foundations of inventory management,* McGraw-Hill, NY.
Zwass, V 2003, 'Electronic commerce and organizational innovation: aspects and opportunities', *International Journal of Electronic Commerce*, vol. 7, no. 3, pp. 7-37.

Appendices

Appendix 1: Some of the main GS1 products and services

This section describes some of the main GS1 products and services. The information provided below is from GS1 web sites and their learning materials (GS1 Organisation 2010; GS1 Australia 2010).

1. GS1 Bar-coding number and system (GTIN)

The barcodes and GS1 Identification System have provided benefits to consumers around the world for over thirty years. A barcode (technically called GTIN or Global Trade Item Number) is a number represented in vertical lines of varying widths printed on labels to uniquely identify items. The barcode labels are read with a scanner which measures reflected light and interprets the pattern of reflection into numbers and letters that are passed onto a computer to retrieve original product data. A barcode enables the rapid and unambiguous identification of products, assets, documents and people. Using a barcode can greatly reduce human errors in data entry and processing, eliminate ambiguities caused by inconsistent approaches to product labelling and mistakes in reading handwriting.

Barcodes were first used by supermarkets to automate the checkout process. Due to the ease and speed the barcode provided retailers and customers, they are now used by retailers across the world. Below is an example of a GS1 barcode.

Figure 1: An example of a GS1 barcode

Source: GS1 Organisation 2010/ Learning materials

The GS1 barcode offers benefits to all parties in the trading cycle by reducing costs, saving time, and increasing accuracy and efficiency through management of the entire supply chain. Some of the benefits are presented in table 1.

Table 1: Some of the benefits of GS1 barcodes for different supply chain players

For Trading partners	For Manufacturers	For Wholesalers	For Retailers
The ability to identify goods and shipments quickly and accurately	Automated counting and sorting on the production line	The ability to order, receive, pick and despatch goods faster, with greater accuracy	An accurate, efficient source of sales data
Faster delivery of goods	Ability to track products through manufacturing and delivery	Improved inventory and stocktaking	Reduced administration costs
Fewer handling and shipping errors	Ability to obtain real sales data from a retailer and use it to plan production schedules which reflect actual consumer demand	Support for applications such as cross-docking	Fewer products out of stock
Better inventory	Ability to include attribute information such as batch numbers, use-by dates and serial numbers in one barcode which can be read by all trading partners	Faster, more efficient service at POS	

Source: GS1 Organisation 2010/ Learning materials

2. GS1 System

The GS1 System is a set of global standards, which enable the unique identification of all trade items, processes, services, shipments, assets, companies and locations at any point in the supply chain. The system can be used by all industries to facilitate trade by combining unique identification numbers with data carriers (e.g. barcodes) and electronic commerce processes.

The three main components of the GS1 System are:

- Standards numbering structures for the identification of goods, services, shipments, assets and locations
- Data carriers (usually a barcode) to represent the identification numbers in machine readable format
- E-Messaging standards to transmit the captured data between trading partners

The GS1 System is a universal global standard - so all users follow the same coding rules. As a result, GS1 numbers and barcodes can be recognised by trading partners anywhere in the world. The GS1 System is administered by GS1 global, based in Brussels. With member organisations in over 100 countries, the integrity and compatibility of the system worldwide is ensured. The GS1 System offers benefits to all parties (trading partners, manufacturers, wholesalers and retailers) in the trading cycle by reducing costs, saving time, and increasing accuracy and efficiency through management of the entire supply chain.

3. GS1 Data synchronisation

The GS1 Global Data Synchronisation Network (GDSN) is built around the GS1 Global Registry, GDSN-certified data pools, the GS1 Data Quality Framework and GS1 Global Product Classification, which when combined provide a powerful environment for secure and continuous synchronisation of accurate data.

With GDSN, trading partners always have the latest information in their systems, and any changes made to one company's database are automatically and immediately provided to all of the other companies who do business with them. When a supplier and a customer know they are looking at the same accurate and up-to-date data, it is smoother, quicker and less

expensive for them to do business together. The GDSN provides a single point of truth for product information.

The GS1 Global Data Synchronisation Network connects trading partners to the GS1 Global Registry via a network of interoperable GDSN-certified data pools. Within this Network, trade items are identified using a unique combination of the GS1 Identification Keys called Global Trade Item Numbers (GTIN) and Global Location Numbers (GLN).

There are five simple steps that allow trading partners to synchronise item, location and price data with each other:

1. Load Data: The seller registers product and company information in its data pool.

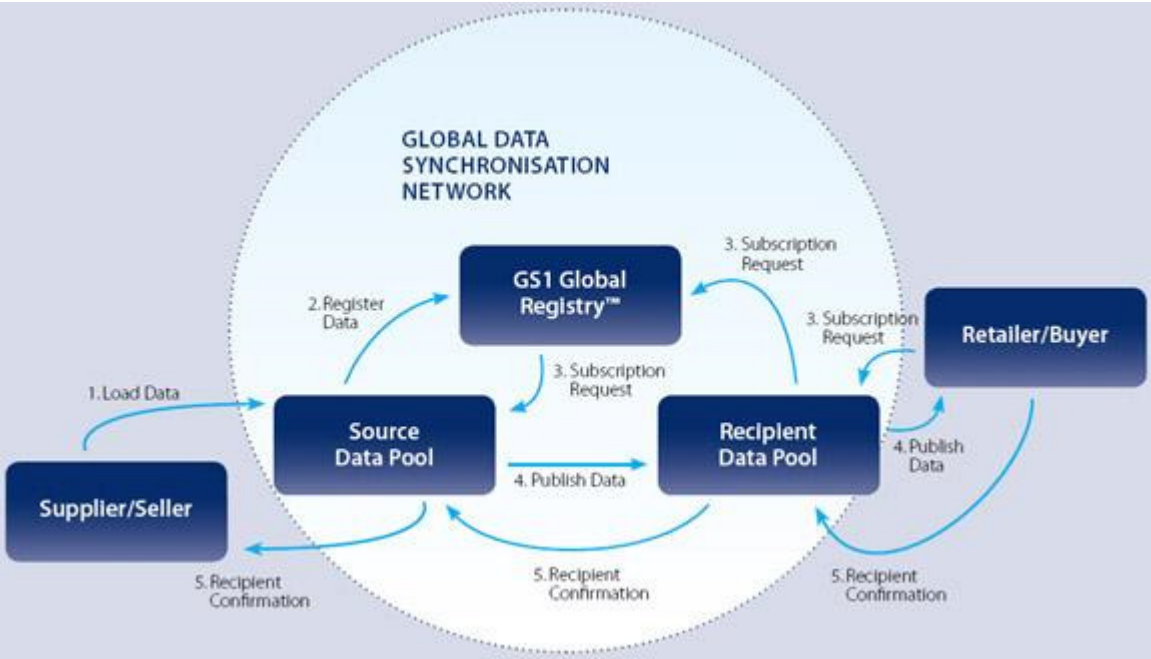
2. Register Data: A small subset of this data is sent to the GS1 Global Registry.

3. Request Subscription: The buyer, through its own data pool, subscribes to receive a seller's information.

4. Publish Data: The seller's data pool publishes the requested information to the buyer's data pool.

5. Confirm & Inform: The buyer sends a confirmation to the seller via each company's data pool, which informs the supplier of the action taken by the retailer using the information.

Figure 2: Global Data Synchronisation Network



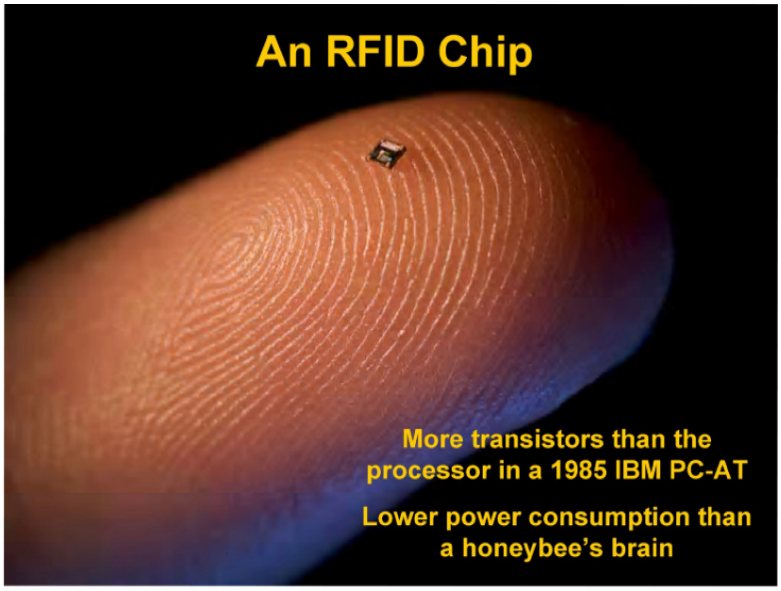
Source: GS1 Organisation 2010/ Learning materials

4. GS1 electronic product code (EPC) standards for RFID technology

EPC global is leading the development of industry-driven standards for the Electronic Product Code/ EPC to support the use of Radio Frequency Identification, /RFID in today's fast-moving, information rich, trading networks. The EPC global network is a suite of tools utilising RFID technology for automatic identification of items moving through the supply chain. It uses the principle of the Internet to easily locate and exchange information.

The Electronic Product Code or EPC is a set of identification coding or numbering standards. Unlike the barcodes commonly used to distinguish a can of soup from a box of chocolate chip biscuits, the EPC can identify a specific can of soup or box of biscuits by its unique ID number. The EPC contains no personal information. Radio frequency identification or RFID is a technology that allows the identification of tagged items without a line of sight. It includes a tag, a reader and a computer system. A RFID tag containing a tiny microchip (see figure 3) and an antenna is placed on an object. Most of the RFID tags, which usually carry information in the form of a unique serial number, require no external power.

Figure 3: An RFID chip



Source: GS1 Organisation 2010/ Learning materials

5. GS1 dataBar

GS1 DataBar Symbols (formerly known as RSS) can identify small items and carry more information than the current GS1 Barcode Symbol. GS1 DataBar will enable barcode (Global Trade Item Number (GTIN)) identification for hard-to-mark products like fresh foods, and can carry GS1 Application Identifier such as serial numbers, batch/lot numbers and expiration dates, which creates the opportunity for solutions supporting product authentication and traceability, product quality and effectiveness, and variable measure product identification. GS1 has announced a global sunrise date of January 2010 for all scanning systems to read GS1 DataBar Symbols on any trade item.

6. GS1 net

GS1net is the data synchronisation solution for the Australian and New Zealand community. GS1net enables you to enter, validate, store and maintain all your product, pricing and other related trade information in a single location. You can then easily share this global standards-based information with the trading partners you work with, across all industry sectors, in Australia, New Zealand and around the world. GS1net is a certified data pool that is part of a global network, the GS1 Global Data Synchronisation Network (GDSN), a powerful

environment for secure and continuous synchronisation of accurate data. For a glossary of terms, refer to section 'GS1net Concepts and Key Terminology'. GS1 Australia and New Zealand are working with members in more than eighteen industry sectors and GS1net is endorsed locally across more than five of these sectors including supermarkets, liquor, healthcare, automotive aftermarket and hardware.

7. GS1 education and training

GS1 provide training courses as well as training material, infrastructure and services to their members. GS1 by providing classroom training sessions and online courses for their members, allow them to get supply chain management knowledge they need for implementing GS1 products and services more efficiently.

Appendix 2: Characteristics of companies and interviewees' profile (SC professionals' interviews)

Participant number	Company[3] size	B2B enabling technologies	GS1 products and services	Company's role in SC	Job function
1	Small	Email & Internet	None	Manufacturer	SC and logistics manager
2	Small	Email & Internet	None	Manufacturer	Operations manager
3	Small	Email & Internet; Web site for providing products and services information	GS1 barcode	Assembler Manufacturer	Operations manager
4	Medium	Email & Internet; Web site for providing products and services information; Web site for conducting transactions; Extranet; ERP (SAP); EDI; Barcode	GS1 barcode; GS1 system; GS1 data synchronisation; GS1 data bar; GS1 net; GS1 education and training	Wholesaler Distributor	National 3PL and 4PL manager
5	Medium	Email & Internet	None	Manufacturer Retailer	Production manager
6	Large	Email & Internet; Web site for providing products and services information; Web site for conducting transactions; Extranet; ERP (SAP); Barcode; RFID	Barcode	Manufacturer	Logistics and operations manager
7	Large	Email & Internet; Web site for providing products and services information; Web site for conducting transactions; Extranet; ERP (SAP); EDI; Barcode; RFID	GS1 barcode; GS1 electronic product code (EPC)	Assembler Component supplier Sub-assembler Manufacturer	SC manager
8	Large	Email & Internet; Web site for providing products and services information; Web site for conducting transactions; ERP (SAP); Barcode	GS1 barcode	Wholesaler Distributor Retailer	Procurement and purchasing manager

[3] The sampling frame was set to include large sized companies with 200 employees or more, medium sized companies with 20 to less than 200 employees and small sized companies with less than 20 employees (ABS 2002).

Appendix 3: Informed consent form and interview protocol

Research Information Statement and Informed Consent Form

Research Topic: The impact of electronically-enabled supply chains on channel relationships and firm performance

Thank you for agreeing to participate in this PhD research. I am currently undertaking research for my Doctor of Philosophy degree. The purpose of the research is to examine how electronic supply chain practices can contribute to supply chain integration and firm performance.

The interview will be audio recorded (to ensure that I capture all your comments) and then be transcribed, deleting all identifying names of individuals, organisations or places. I may use non-attributed quotes as well as generalised statements in reporting the study.

The outcome of this study may also be published in relevant journals and conferences dedicated to supply chain management and operations management. It is expected that these articles will be educational and useful for the supply chain professional community.

INFORMED CONSENT TO PARTICIPATE IN RESEARCH
PLEASE READ AND SIGN:

- I have read and understood the project information statement.
- All questions about the research have been answered to my satisfaction.
- My participation in the research is voluntary.
- I understand that I may withdraw from the research at any time and all the information I have provided will be destroyed.
- I agree that the interview can be audio recorded.
- I agree that a transcript may to be made of the recording.
- I agree that the data collected may only be used for the purposes stated above.
- I agree that transcripts of the interviews will eliminate the names of individuals, organisations or places to ensure anonymity, confidentially and privacy of myself and others.

Participant:

Signature..... Date .....

Researcher:

Signature..... Date .....

Interview protocol/ guide

Opening

- Introductions of interviewer and interview participant
- Overview of purpose of the study
- Confidentiality assurance
- Permission to audiotape

Demographic data

- Background on organisation, industry, etc.

  (See segmentation part on the next page)

Main questions

Before starting to ask the questions from the interviewee, all terms and concepts which are related to the research model (e.g. constructs, examples) are explained briefly to the interviewee by the researcher.

- Tell me about the role of electronic integration on ….. in your supply chain relationships

(See the full list of main interview questions are provided on the next page)

Additional unplanned/ floating prompts

- How?
- Describe?
- Can you tell me more about that?
- Will you explain that in more detail?
- Can you give me examples or tell a story of an experience about that?
- How does that work?
- Tell me about a time when that did not happen

The interview protocol guide followed recommendations by McCracken (1996).

Interview questions

Segmentation questions related to profile of interviewees and the companies:

1. Job function of the interviewee
2. Which Types of B2B technologies the company uses
3. If they are a member of GS1 Australia, which types of GS1 products and services they have implemented in their company
4. Size of the company (annual sales and number of employees)
5. Company's role in SC

Interview main questions

IT capabilities related questions:

1(a) How and in what manner has electronic integration had an impact on information sharing between your company and your SC partners?

(b) How and in what manner has electronic integration had an impact on SC coordination between your company and your SC partners?

2(a) How and in what manner has human IT resources had an impact on information sharing between your company and your SC partners?

(b) How and in what manner has human IT resources had an impact on SC coordination between your company and your SC partners?

3(a) How and in what manner has IT integration strategy had an impact on information sharing between your company and your SC partners?

(b) How and in what manner has IT integration strategy had an impact on SC coordination between your company and your SC partners?

4(a) How and in what manner has your company's top management support to IT (CEO commitment to IT) had an impact on information sharing between your company and your SC partners?

(b) How and in what manner has your company's top management support to IT (CEO commitment to IT) had an impact on SC coordination between your company and your SC partners?

5(a) How and in what manner has customer orientation had an impact on information sharing between your company and your SC partners?

(b) How and in what manner has customer orientation had an impact on SC coordination between your company and your SC partners?

SC channel capabilities related questions:

6(a) How and in what manner has information sharing among your company and your SC partners had an impact on your SC coordination?

(b) How and in what manner has information sharing among your company and your SC partners had an impact on your SC responsiveness?

7 How and in what manner has SC coordination among your company and your SC partners had an impact on your SC responsiveness?

Firm performance related questions:

8 How and in what manner has information sharing among your company and your SC partners had an impact on your company's performance (financial and market)?

9 How and in what manner has SC coordination among your company and your SC partners had an impact on your company's performance (financial and market)?

10 How and in what manner has SC responsiveness among your company and your SC partners had an impact on your company's performance (financial and market)?

Appendix 4: Details of the analysis of the interviews (SC professionals' interviews)

Prior to the interviews, the researcher explained to the interviewees the research conceptual model and its salient features including all of the constructs and their components. All interviewees were asked the same questions in the same order and manner. The questions were posed in a semi-structured format. Each interview took approximately one hour.

A4.1 Data coding and analysis

Data coding and analysis was conducted using content analysis. Content analysis begins with identifying words, sets of words or phrases that are most used by interviewees. The researcher first read through the collected data and tagged key phrases and texts that were relevant to those questions. Then, the collected data was examined again in detail by reading through the text, writing down concepts and classifying number of cases into the right categories. Information that appeared to add nothing to the analysis was discarded. This process was undertaken manually. After data coding, frequency counts were used to give a broad overview of participants' views. A more in-depth analysis was later conducted to elicit the main aspects of participants' views.

A4.2 Interview findings

Interviews were transcribed by the researcher, immediately following each interview. Each transcript was reviewed twice (while simultaneously listening to the interview tape), and theme-codes were assigned to each paragraph. The information received was broadly apportioned to the following three categories:

1- Factors that measure the impact of IT capabilities (electronic integration, human IT resources, IT integration strategy, top management support and customer orientation) on information sharing and SC coordination;
2- Factors that measure the impact of information sharing on SC coordination, and also the impact of information sharing and SC coordination on SC responsiveness;
3- Factors that measure the impact of SC channel capabilities (information sharing, SC coordination and SC responsiveness) on firm performance (financial and market performances).

A4.2.1 Impact of IT capabilities on information sharing and SC coordination

This section investigates the manner in which different IT capabilities (electronic integration, human IT resources, IT integration strategy, CEO commitment and customer orientation) impact on information sharing and SC coordination activities.

A4.2.1.1 Impact of electronic integration on information sharing and SC coordination

Question 1(a) How and in what manner has electronic integration had an impact on information sharing between your company and your SC partners?

Question 1(b) How and in what manner has electronic integration had an impact on SC coordination between your company and your SC partners?

All participants except participant numbers 2 and 5 supported the positive direct relationship between electronic integration and information sharing (Question 1a). Only four (4, 6, 7 and 8) agreed that electronic integration has a direct positive impact on SC coordination. Participants 6, 7 and 8, who were from large sized companies which utilised various IT technologies (such as Email, Internet, Extranet, ERP and EDI) in relation to their SC partners, indicated that sending/receiving promotion plans and sales data electronically to/from supply chain partners improved *visibility*[4] and *transparency* in information sharing process, and therefore, they (participants) were able to better manage inventory levels for themselves and their supply chain partners. For example, participant 8 remarked:

"As I said, our suppliers get regular updates from our promotion plans and our sales data electronically. These information exchanges via IT technology are very important for our suppliers to manage their stock and their inventory levels and to better coordinate with their own suppliers in order to deliver the supplies in the right quantity and at the right time to us."

Participant 6 had this to say:

"With visibility of stocks through IT, now we can improve our stock covering days and improve our company's product freshness compared to before, which can reduce everyday waste that is related to a huge cost."

[4] Keywords/categories are stated in italics.

Additionally, participant 7 noted that *frequency* of information sharing with supply chain partners increased by having electronic communication (exchange of sales and production data).

Participant 4, who was from a medium sized company which used different IT technologies (Email, Internet, Extranet, ERP and EDI) in relation to their suppliers, noted that having access electronically to major suppliers' inventory levels led to increasing the amount of *accurate* information sharing:
"Definitely information replaces inventory, and using the electronic data interchange system in my company accelerated the amount of accurate information exchange between my company and our suppliers."

Participants 1 and 3, who were from small sized companies with low level IT usage (Email and Internet), claimed that improving the *speed of communication (faster cycle time)* is an apparent advantage of electronic communication, due to it delivering information much more rapidly than conventional methods. For instance, participant 3 commented:
"Email and Internet has created a main difference in the way we communicate. Within seconds, you can share your information with suppliers and customers and get responses within minutes. We can download relevant information, make reports, send it to our suppliers in the time period that it used to take to send a fax."

Participant 5, who was from a medium sized company with minimum uses of IT (Email and Internet) in relation to their supply chain partners, pointed out that using email for sending data to their suppliers increased the *quantity* of information sharing. He also argued that electronic integration alone does not have a strong impact on information sharing, because of the traditional nature of their supply chain management which is mainly through the use of face to face, telephone or fax for communication with their suppliers. He believes that, in this traditional structure, key people (such as heads of procurement and purchasing) and their contacts (with their suppliers) and experience are more important for effective information sharing, than using IT technologies only.

Participant 2, who is from a small sized company with minimum IT technologies (Email and Internet) in use, believed that IT technologies cannot be significantly effective to information sharing in small sized companies due to having a low level of IT capabilities and resources:

"Lots of our suppliers are too small; they do not have any IT capabilities, also it involves cost. Hundreds of thousands of dollars will be incurred if we want to apply IT capabilities with all our major suppliers. Besides, we are also a small sized company with 'make to order' type products. Most of our products are project-based and we get a limited quantity of orders each year, so because of our type of products, we do not need real time information sharing with our suppliers through IT."

In terms of the impact of electronic integration on SC coordination (Question 1b), as mentioned before only four participants (4, 6, 7 and 8) agreed that this had a direct positive impact. Participants 6, 7 and 8 clarified that electronic integration mostly has a positive impact on SC coordination with their large sized SC partners that have a high level of IT infrastructure and capabilities.

Participant 7 believed that using EDI technology is very crucial in relation to their SC coordination activities. He noted that electronic integration is necessary for being competitive in their market and having *superior price coordination mechanisms (such as quantity discount and return policy)* with their retailers. Participant 6 mentioned that electronic linkage has a positive impact on having better *allocation roles, stocking level, and collaborative planning, forecasting and replenishment* with their large sized SC partners. Participant 8 also commented that electronic integration improved some SC coordination activities in relation to *collaborative planning, forecasting and replenishment (CPFR)* and *vendor management inventory (VMI) activities (such as order delivery processes)* with major large sized supply chain partners. Because of VMI, he had managed to get "A$ 2 million of extra orders last year". Participant 4 noted that electronic linkage is required for *synchronising their SC activities* in order to *improve delivery time*:
"For my company, on-time delivery is very important, and our suppliers should be able to communicate with us online in order to have efficient coordination with them."

On the other hand, participants 1, 2, 3 and 5 claimed that electronic integration does not have a direct positive impact on their SC coordination. Participants 1, 2 and 3 mostly referred to their companies' size (small) and minimum level of IT resources and capabilities as an issue in this relation. For example, participant 1 said that electronic integration cannot have a positive impact on their SC coordination when their suppliers do not have adequate IT platform, knowledge and experience.

Participants 1, 2 and 3 believe that SC coordination through electronic integration is a costly process and it is not beneficial at the end. Participant 2 said that because of their type of products (make to order) and small quantity orders each year, using IT technology for SC coordination activities is expensive and unnecessary. Participant 5 noted lack of training, standards and knowledge internally and among their suppliers as issues and limitations when using electronic linkages in coordination activities:

"Our company's strength is on project-based products [engineering to order]. Therefore, we have to get the coordination of the project right. There is a huge amount of coordination. The issue is our suppliers need to be trained for coordination via electronic integration. They [suppliers] can coordinate their own project very well, but they cannot report it electronically [as] there is no standardisation with them."

A4.2.1.2 Impact of human IT resources on information sharing and SC coordination

Question 2(a) How and in what manner has human IT resources had an impact on information sharing between your company and your SC partners?

Question 2(b) How and in what manner has human IT resources had an impact on SC coordination between your company and your SC partners?

Only four participants (3, 4, 7, and 8) believed that human IT resources have a direct positive impact on their information sharing, and only three participants (4, 7, and 8) support that human IT resources have a direct positive impact on SC coordination. Participants 7 and 8 mentioned that they spend large amounts of money on their IT developments. Their IT departments have a very important role on *providing effective IT systems and technologies* related to managing their supply chain and also *training their staff* for implementation of the technologies. Through their IT departments, their companies were able to support some of their suppliers for *establishing B2B e-commerce technologies* and even GS1 standards and systems for better communication and for their mutual benefit:

"Most of the time we have some of our suppliers asking us for help in applying GS1 compliances and doing stuff electronically. So we help them to establish the GS1 and IT systems and processes with the assistance of our IT staff" (Participant 7).

In addition, participant 8 believed that *disintermediation* is the other positive result of the impact of human IT on SC coordination. Disintermediation is the cutting off (or skipping) of one echelon in the supply network (Slack, Chambers & Johnston 2004). He explained that with the help and support of their IT department for establishing B2B enabling technologies and processes with some of their partners, they were able to practise disintermediation during cross-docking.[5]

Participant 4 indicated that human IT resources are crucial in order to *provide B2B e-commerce platforms* in relation to information sharing and SC coordination with their SC partners for developing processes of some of their projects and products. Participant 3 said their human IT resources were important in *developing, upgrading and maintaining their IT systems and the company's web site* for communication and information sharing with SC partners. However, he believed that human IT resources could not improve their SC coordination, because IT systems and process changes required for SC coordination activities were very expensive, unnecessary and would not increase efficiency.

The rest of participants did not support the direct positive impact of human IT resources on either information sharing or SC coordination. Participants 1 and 2 outsourced their human IT to other IT solution providers. Human IT resources were only related to their internal integration activities and plans (e.g. implying SAP system was only used for internal purposes) in their companies and not with their external suppliers.

Moreover, participants 5 and 6 believed that human IT resources could at times be problematic and cause certain limitations and issues in managing their SC. Participant 5 said:
"But in many situations, IT becomes itself the main business, and not being supportive to the company's business purposes. They [IT department] think the business is around them, therefore, we have to follow them. For example, if I as a production manager call them and say that I need this particular service, they tell me we cannot provide this, but we can give you this [service]. I say I do not need this, I need that one. They say, no, this is not in the corporate policy … For improving production and inventory control, I need that one, but they give me this one and I cannot use this. In many situations such as when implementing and

[5] Cross-docking is a practice in logistics of unloading materials from an incoming semi-trailer truck or rail car and loading them directly into outbound trucks, trailers or rail cars, with little or no storage in between.

using software, hardware … this issue exists. Sometimes they respond to your enquiries but most of the time they create problems and delays."

Participant 6 mentioned that he did not have access to their IT department directly and he believed they did not provide any useful services and support for his department. He stated that most of the new systems and processes implemented by the IT department in the company were not improving efficiency. For example, when the IT department established a new IT system, it had many bugs, was not easy to use (not user friendly) and not related to their current business requirements.

A4.2.1.3 Impact of IT integration strategy on information sharing and SC coordination

Question 3(a) How and in what manner has IT integration strategy had an impact on information sharing between your company and your SC partners?

Question 3(b) How and in what manner has IT integration strategy had an impact on SC coordination between your company and your SC partners?

The data revealed that all participants supported a direct positive impact of IT integration strategy on information sharing. Participants 4, 5, 6, 7 and 8 indicated that IT integration has a direct positive impact on SC coordination as well.

Participants 7 and 8 who agreed with the positive impact of IT integration strategy on both information sharing and SC coordination talked about its importance in *improving IT effectiveness* in their supply chain processes and activities:
"We have been working to develop IT systems which intend to support our operations for many years. These systems make it easier for us to handle ordering, delivery, replenishing, picking and final delivery of the goods. Our priority has always been to make use of modern technologies to improve the efficiency with which both goods and information is handled. All systems which affect the handling of goods are fully integrated, that is to say, the information is only registered once and is displayed in real time" (Participant 7).

Participant 8 also commented that strong IT integration strategy helped increase *effective application of IT* in their business processes which are necessary for process improvements and having a better outcome. He said that they had short, medium, and long-term plans for

their business strategies and requirements, and their IT models and plans were established on the back of those business strategies:

"Every year, the IT department sits with the CIO [chief information officer] and discusses the direction which the IT department is heading annually. The discussion focuses on the future plans of the IT department, which is then used in the business model."

Participants 4, 5 and 6 noted that with better IT integration strategy their IT department would be more *responsible* and *responsive* to real business requirements and enquiries, and therefore they would be able to provide better services (software and hardware) and training for using the new technologies. This responsiveness by the IT department through IT integration was also supported by participant 6 as an important approach for *problem prevention* or *early detection of issues* in using these new technologies. Participant 5 said:

"It definitely has a positive impact, but this integration should not push your company towards a restricted, limited, communist world of IT. For example, when they [IT department] install a new system, I could not do anything with my computer, I could not even use the CD drive, everything was being saved in the central server. For example, I wanted to install a software for a simulation analysis, I could not install it. Another example: they say our policy is to use Internet Explorer in the whole company. And I say I want to use Firefox instead of Internet Explorer. They say, no, the Internet Explorer is for everybody … Firefox has some advantages for some people. I was using Firefox for years and I could work with it faster … so the IT integration should not push you to a halt. IT should support our overall business plan, and not the other way round."

Participants 1, 2 and 3 pointed out the importance of IT integration for *creating advanced development in their supply chain process* specifically in relation to information sharing. Participant 3 mentioned:

"I am guided by the CEO and the direction provided by the board to do those things [information sharing and SC coordination] related to supply chain management. How I do that depends on the availability of tools, whether it's IT infrastructure or knowledge and skills. It is directed by the vision of IT integration and influence and efforts put in this area. For example, in future, we will use an ERP system then we will be smarter inside. This means our system for measuring our suppliers' performance will change. Our suppliers will be measured in a more transparent way and we will use online measurement and online booking for our related transportation companies."

Participants 1, 2 and 3 also mentioned that most of their SC coordination activities with their SC partners are not through an IT platform. Reasons for not using IT for SC coordination are due to low IT capabilities and it being expensive and would not yield efficiencies. Participant 1 commented:

"We just have IT integration for internal purposes [internal integration]. But there is no strategic plan for using IT technology for our coordination activities with suppliers, because it is not required and it is not beneficial for us."

A4.2.1.4 Impact of CEO commitment to IT on information sharing and SC coordination

Question 4(a) How and in what manner has your company's CEO commitment to IT (top management support to IT) had an impact on information sharing between your company and your SC partners?

Question 4(b) How and in what manner has your company's CEO commitment to IT (top management support to IT) had an impact on SC coordination between your company and your SC partners?

All participants agreed that all *large IT investments (resources)* for their companies were directly dependent on their CEO's decisions and support. Nearly all of the participants (1, 2, 3, 4, 5, 6 and 7) also mentioned that top level management support for *establishing and transforming IT systems and applications* for information sharing processes with their SC partners was critical and necessary. Participants 4, 5, 6, 7 and 8 believed that CEO commitment to IT had a direct positive impact on SC coordination.

Participant 7 in relation to the importance of their CEO support for *providing sufficient resources (funds and time)* for integrating information sharing and SC coordination processes with some of their SC partners said:

"Last year, we started two projects with our key suppliers, and we had a commitment to develop their IT systems to coordinate with our system that took four and half months with a huge amount of investment. That could not be done without a high level of IT commitment by our CEO for electronic integration."

Participant 8 mentioned that their CEO has several meetings with their IT department staff and specifically with their IT managers for *setting IT direction* each year and *using their feedback in the business model* for information sharing and coordination activities.

Participants 4 and 6 indicated the importance of their top management's vision and their directions for *using e-commerce technologies with their suppliers (IT external usage)*. For instance, participant 6 said that, after their top management's recent decisions, it is now compulsory for his department for selecting vendors and even in their purchasing contracts to consider suppliers that have certain IT capabilities and able to communicate with them electronically. Participant 4 also mentioned that with the support of his senior manager, it is now compulsory for all their suppliers (especially small sized) to send their monthly stock report by email to his company.

Although participant 5 agreed about the positive impact of CEO commitment to IT on information sharing and SC coordination, he believed that in a large sized organisation this positive impact depends on several layers of decision making as well:
"They [top level managers] can be important, but it has to go across all levels of organisation layers. But they have to have a strategy about how to use and how to integrate IT, not to misuse IT. But at the same time it depends on lower levels [operational levels] for executing the decisions. Because at the end of day, I will call the IT technicians for help and if they do not follow the company's policies, it is not going to work. Thus, they can be influential on information sharing and SC coordination via other people in different layers of the company."

On the other hand, participants 1, 2 and 3 believed that most of the IT related SC coordination projects were usually long-term, expensive and intangible. Therefore, the CEO is generally not committed to these types of projects. For example, participant 1 in relation to CEO commitment for using IT in their SC coordination activities said:
"But lots of these electronic integration activities are very time consuming, costly and sometimes intangible and the CEO is not committed to them, and they [CEO and board] wanted something that has short-term returns and benefits. In our company, the IT integration plan and the desire exist; but the issue is the lack of commitment of the CEO towards long-term results."

A4.2.1.5 Impact of customer orientation on information sharing and SC coordination

Question 5(a) How and in what manner has customer orientation had an impact on information sharing between your company and your SC partners?

Question 5(b) How and in what manner has customer orientation had an impact on SC coordination between your company and your SC partners?

All participants except participants 1 and 2 believed customer orientation has a direct positive effect on information sharing and SC coordination. Participants 4, 6 and 8 noted that *providing accurate information* (e.g. delivery time and order fulfilment) for their customers through their online system or database was very important for good customer service and could not be possible without having strong information sharing and SC coordination with their SC partners:

"For having a good relationship with our customers, we have an online system, so when customers are looking for some information related to their orders; they can go to the web site [online] and look for the information. So they know where their products are, therefore they are not going to call us every day and say where is this, where is that. They know what is involved" (Participant 8).

Participant 6 also said:

"With this data visibility [via IT] our customers are aware of our product availability and it helps us to tell our customers how much of the order is completed and when the order will arrive to replenish the stock."

Participants 3 and 7 mentioned that *producing and utilising market information* are key aspects of customer orientation in the market. Having knowledge of what exactly the customers want led to a more accurate forecasting of the demand which in turn would improve information sharing and SC coordination:

"At customer level, we have our own online ordering system [SOS – simple ordering system]. So we have all our sales forces trained [through our IT department], so they install the software free of charge on our customers' computers that give the customers virtually real time visibility on our stock system – they can check their electronic invoices online … so as

the customer orders, we can check the demand pattern, the usage and we can obtain forecast figures from that" (Participant 7).

Participant 5 said that their corporate strategy was closely connected to their customer requirements. He believed that having *regular exchange of information with customers* was necessary for getting feedback from the market, and this feedback has a positive impact on their information sharing and coordination. He also emphasised the importance of *quality improvement* on customer orientation: "With the SC coordination, now we are able to deal with quality issues proactively, which is very important for our main customers."

However, participants 1 and 2 did not support the direct positive impact of customer orientation on information sharing and SC coordination. Participant 2 noted that because of small quantity orders, customer orientation does not have a significant influence on their information sharing and SC coordination with their suppliers. Participant 1 also said that customer orientation indirectly, through their CEO's decisions and policies, can have a positive impact on information sharing and SC coordination.

A4.2.2 SC channel capabilities: Information sharing, SC coordination and SC responsiveness

This section investigates the relationships among three different SC channel capabilities (information sharing, SC coordination and SC responsiveness) and how and in what manner they impact each other.

A4.2.2.1 Impact of information sharing on SC coordination and SC responsiveness

Question 6(a) How and in what manner has information sharing among your company and your SC partners had an impact on your SC coordination?

Question 6(b) How and in what manner has information sharing among your company and your SC partners had an impact on your SC responsiveness?

All participants agreed that in order to be responsive and to have better coordination with their SC partners, having proper information sharing was important and necessary. All except participants 4 and 7 noted that *accuracy, quality* and *speed* of information sharing have a

direct positive impact on their SC coordination and responsiveness. Participants 5, 6 and 8 clarified that having *accurate information* about their suppliers' stock level, status of order and timing of the shipment to replenish the stocks would help to better synchronise the activities such as lead time and deliveries. For example, participant 6 said:
"I think it is always better to work on a formal set of data because when the information is not transparent, entities in the supply chain will have different sets of figures and ultimately we will be working with different lead times, add-ups [cost details] and things like that."

Participant 5 said that the *quality of information* such as point of sale data in information sharing is important in reducing demand uncertainty and improving responsiveness:
"As a result of the ability to see information about our customers, their needs are identified faster and this facilitates forward planning. By avoiding unnecessary production, waste can be eliminated. This also provides information about what is selling fast at the customer's store. Because of this information, we are able to chase new orders ahead of our competitors."

Participants 1, 2 and 3 commented that *real time* information sharing had a direct positive impact on their SC coordination and responsiveness. Participant 1 said that this helps them to reduce the waste of unnecessary purchases and returns and provides the opportunity for their logistics system to rapidly adjust their warehouse capacity to address unexpected demand changes. Participant 3 noted that real time tracing and tracking information with their distributors improved their lead times and deliveries that led to better customer satisfaction. Participant 2 also believed better flexibility in SC coordination and responsiveness is a result of real time information sharing with SC partners. By having access to real time information in relation to demand changes, their production operations were able to rapidly reconfigure equipment to address changes to products volume and variety.

Participants 4 and 7 stated that having proper information sharing and the ability to *communicate on a wide range of issues* created a platform for better *informed decision-making*. In other words, the ability to include different entities' data and information in their decision making process has led to coordinated decision making and a better service for their customers. For instance, participant 7 said that:
"With this information exchange I can seek consultations from other entities in the supply chain in terms of references, prices, storages and delivery."

A4.2.2.2 Impact of SC coordination on SC responsiveness

Question 7 How and in what manner has SC coordination among your company and your SC partners had an impact on your SC responsiveness?

All participants supported the positive impact of SC coordination on SC responsiveness. The participants indicated many different factors that can measure the positive influence of SC coordination on SC responsiveness. Participants 6 and 7 believed that *competitive pricing* and *return policy* were essential for being responsive in the market. Participant 6 specifically referred to *better promotion plan* and *discount policy* as the positive influence of SC coordination activities on their SC responsiveness:

"If you want to promote or provide discounts for products to increase your market share, you need to have coordination with your SC partners, in order to procure products. Then, when our customers place an order, we are sure that we are able to deliver it to them in the right time and quantity."

Participants 5 and 8 commented that having *faster order response time* and *higher order fill rate* as advantages of proper SC coordination on SC responsiveness. For example, participant 8 said:

"I think in purchasing we are well ahead of the competition [in the industry]. That is the feedback we got from our own suppliers; because our response time is much faster, accuracy of our information is far better and also the way we coordinate with suppliers is also quite different; because our suppliers' relationships, same as our customer relationships, are very important to the business."

Participant 5 also clarified that, in volatile markets, SC coordination has a very important role on the *higher order fill rate*:

"In our industry, we have to be coordinated with our suppliers, otherwise we would have so much waste, for example, the loss of time, loss of production and most importantly the customers would not be able to get their product."

Participant 4 referred to *product availability* as an example of the positive impact of SC coordination on their SC responsiveness:

"If your market grows, this requires higher SC coordination. Otherwise, your SC responsiveness will not be effective because, at the end of day, SC responsiveness will satisfy the market. If these two [information sharing and SC coordination] go wrong and we do not have enough stock in our warehouse, we cannot supply our market, our customers will have a negative experience. So if our customers are not satisfied, they will leave, and therefore there will not be any allocation of funds, which is required for large order volumes."

Participants 1 and 3 believed that one of the barriers to being SC responsive is the *demand uncertainty* and this can be reduced by better coordination with their SC partners. For instance, participant 3 pointed out:

"SC coordination is about management of uncertainty. Because we do not know, or we are late, or we do not have this machine [it is broken] or due to some other reasons, this SC coordination becomes the management of these uncertain events. So because the demand always changes and it is dynamic and uncertain, we have to have good coordination in order to be responsive."

Participant 2 supported the positive impact of SC coordination through *new product development* on their SC responsiveness; he also indicated that time, resources and knowledge were some of the barriers for them and their suppliers in relation to having better SC coordination and SC responsiveness:

"That has proven to be successful [SC coordination ➔ SC responsiveness] especially for us in product development. But there are issues of time, resources and knowledge that are required to coordinate with SC partners and make them understand, for mutual benefits. So it is a hard thing, but it has an impact on responsiveness."

A4.2.3 Impact of SC channel capabilities on firm performance (market and financial performances)

This section investigates the relationship between three different SC channel capabilities (information sharing, SC coordination and SC responsiveness) on firm performance of which the focus is only on a firm's financial and market performances.

Question 8 How and in what manner has information sharing among your company and your SC partners had an impact on your company's performance (financial and market)?

All participants agreed and indicated many factors that can measure the direct positive impact of SC channel capabilities on market and financial performances. In terms of the impact of information sharing on financial and market performances, they noted the significant role of information sharing on many advantages in their supply chain relationships. These include: *improving decision making, reduction in inventory costs (inventory level and safety stock), improving production planning, reduction in demand uncertainty, increasing the accuracy of demand forecast, improving capacity planning,* and *better tracing of customer orders.* They believe these advantages lead to overall cost reduction, improved return on investment and rise in profitability in relation to financial performance and sales growth, improving market position, and delivering better value to customers which related to market performance.

For example, participant 7 said:
"There is a direct correlation between the inventory levels in the balance sheet and better control and forecasting of inventory. There is a principle in our company, if we improve purchasing capability, we can save 2 or 3 percent on the purchasing cost. So the difference between a poor purchasing company and a professional procurement company can be a saving of 2 or 3 percent. It has a direct impact on the bottom line."

And as another example, participant 5 noted that:
"When we have late delivery or shortage [of product], then we have to provide products using special and more expensive delivery methods. So we pay three times more than what we used to pay by trucks. So, when this scenario takes place, we not only lose money, but we lose our customers as well."

Question 9 How and in which way has SC coordination among your company and your SC partners had an impact on your company's performance (financial and market)?

Participants indicated many benefits as a result of their coordination activities with their SC partners. These benefits consist of: *improving product quality, daily order quantity, lead time, delivery schedule, production schedule,* and *order fulfilment rate.* The benefits also lead to *reduction in demand uncertainty, reducing production waste, having a better promotional plan and discount policy,* and *competitive pricing strategy.* In relation to financial

performance, these results can lead to an overall cost reduction, increased efficiency, improved return on investment and a rise in profitability. In relation to market performance, they can lead to improving market position, overall product quality, sales growth, customer service level, market share growth and customer satisfaction.

For example participant 8 mentioned:
"Lots of people, as a result of implementing coordination activities, expect immediate cost reduction. That is not good a way of measuring value in SC coordination. We should look at coordination as value that may not be purely financial. Efficiency, accuracy, responsiveness are the results of coordination. We might not be able to put a tangible dollar value on it but it will result in a return on investment."

And participant 3 said:
"Most of our company's improved market performance is from product design, which is related to the product life cycle, and getting the right product. At the end of the day, that gives our company a standing in the market in terms of how fast we deliver products to the market. However, if it is not the right product, it is not important as to how fast you can deliver it with better coordination."

Question 10 How and in what manner has SC responsiveness among your company and your SC partners had an impact on your company's performance (financial and market)?

Participants believed that SC responsiveness activities have several advantages in better managing the SC and on the performance of their SC. These include: *higher product availability, product variety and customisation, improving delivery time, better response to customer enquiries, distribution lead time* and *product development.* They noted that these advantages can lead to increasing overall marketing effectiveness, sales growth, customer satisfaction, market development, market share and improving customer service levels in relation to market performance. With regard to financial performance, these advantages also have a direct impact on increasing profitability, return on investment and cost reduction.

As examples, participant 4 pointed out:
"I think in health care, the customers are spoilt for choice and this industry therefore has one of the highest responsiveness to the market … it is about 98 percent product availability.

They [customers] get everyday delivery. Customers do expect lots of responsiveness [in terms of product availability and on-time delivery] from us and the level of our SC cooperation [in relation to responsiveness] with our suppliers which directly leads to increasing market share and development in this market."

And participant 2 mentioned:
"Yes, with packaging, it is a huge driver [of SC responsiveness]. For example, if we provide the products in a better easier-to-use packaging, compared to our competitors, this would increase the customer demand and increase our profits."

Appendix 5: Details of experts involved in pre-testing

Following are their details:

Academic experts:

1- An academic with PhD qualification in Operations Management and substantial research experience.

2- An academic with qualification in Logistics and expertise with quantitative methods.

3- Academic with Masters' qualification in Marketing with expertise in quantitative methods.

4- An academic with extensive research and working knowledge of e-Commerce and Information Systems.

5- An academic with expertise in Finance, Economics and Accounting (and also has expertise in business research methods).

Professional experts:

1- SC professional with over 20 years experience as supply chain and logistics manager in large multinational companies in Australia and UK.

2- Chief executive of GS1 Australia with substantial experience in B2B e-commerce technologies in SCM in Australia.

3- Logistics manager employed in one of the major food manufacturers in Australia.

4- Industrial engineer with expertise in SC process improvement in different manufacturing industries and having a PhD in a manufacturing discipline.

5- SC professional with 25 years experience in working in different industries and undertaking consultancy projects in Australia.

Appendix 6: Revision to the survey instrument after pre-testing

Item before pre-testing	Action taken
We share common product codes with the supplier either through the same product code tables or computerized code translation table	Deleted
We provide performance feedback such as the quality of product delivered electronically	Deleted
We access supplier's inventory level of finished products electronically	Combined and wording adjusted
We access the supplier's inventory level of raw materials electronically	
Our IT managers understand our key business processes	Combined and wording adjusted
Our IT manager understand our business strategy	
Compared to our main competitors, we have a relatively small IT group.	Deleted
Our company has clearly identified IT project priorities	Deleted
Our CEO often gets personally involved in matters related to the use of IT within the firm	Wording adjusted
We frequently measure customer satisfaction	Deleted
We pay attention to after-sale service	Deleted
Our information sharing with trading partner is superior to the information exchanged by our competitors with their partners	Deleted
My company conducts transaction follow-up activities more efficiently with our partner than do our competitors with theirs	Deleted
My company has reduced coordinating costs more than our competitors	Wording adjusted
My company can contact the coordinating activities at less cost than our competitors	Deleted
Compared to our competitors, our supply chain develops and markets new products more quickly and effectively	Deleted
My company performs better than our major competitors in return on assets	Deleted
My company performs better than our major competitors in financial liquidity	Deleted
My company performs much better than competitors in sales growth	Wording adjusted
My company performs much better than competitors in product development	Deleted

Appendix 6: Revision to the survey instrument after pre-testing

Item before pre-testing	Action taken
We can trace product failures back to the offending components	Deleted
We can monitor the quality of products produced/purchased by the suppliers electronically	Deleted
There is common understand between out IT managers and line managers regarding how IT can be used to improve process performance	Wording adjusted
Our IT and systems development group has the latest technology and tools available	Wording adjusted
Our CEO is in frequent contact with senior IT management	Deleted
Compared to our competitors, our supply chain responds more quickly and effectively to changing customer and supplier needs	Wording adjusted
In most markets, our supply chain is competing effectively	Deleted
The relationship with our partner has increased our supply chain responsiveness to market changes through collaboration	Wording adjusted

Appendix 7: Cover letter and Questionnaire

Swinburne University of Technology

Faculty of Business & Enterprise

Research Topic: The impact of electronically-enabled supply chains on channel relationships and firm performance

Dear Respondent,

This is a PhD survey in cooperation with GS1 Australia. The survey is targeted at professionals in the area of operations/ manufacturing/ purchasing/ procurement/ logistics/ materials – vice presidents, directors and managers, etc. in Australian companies. The aim of this research is to examine supply chain professionals' perception on how electronic supply chain practices can contribute to supply chain integration and firm performance. It is hoped that the findings of this research will be of benefit to you and GS1 Australia members by assisting you to improve the current supply chain practices to gain competitive advantage. The outcome of this study may be published in relevant journals and conferences dedicated to supply chain management.

This survey consists of four sections and is designed to be completed in 10 to 15 minutes. Please return the completed questionnaire to the researchers by using the stamped self-addressed envelope provided. Your answers will only be seen by the researchers, and only aggregated data or general findings will be reported. No question requests your name or the name of your company which means that you and your company cannot be identified.

Completion of this questionnaire is taken as your Informed Consent to participate in this research. Informed Consent means that all questions about the research have been answered to your satisfaction. Your participation in the research is voluntary and you understand that answering the questions using a mail survey ensures you anonymity, confidentiality and privacy for you and your company.

If you have any questions regarding this PhD research please contact me Faraz Bidar, farazbidar@swin.edu.au or my PhD supervisor Dr. Antonio Lobo, alobo@swin.edu.au

This PhD research has been approved by or on behalf of Swinburne's Human Research Ethics Committee (SUHREC) in line with the *National Statement on Ethical Conduct in Research Involving Humans*. If you have any concerns or complaints about the conduct of this research, you can contact:

Research Ethics Officer, Office of Swinburne Research (H95),
Swinburne University of Technology, P O Box 218, HAWTHORN VIC 3122.

Survey relating to Supply Chain management

SECTION 1

IT capability: This section includes questions on electronic integration, human IT resources and IT complementary organisational resources which all describe your company's IT capability in relation to business to business (B2B) supply chain activities.

SECTION 1.1

Electronic Integration: The following situation describes the extent to which your company has electronic integration via information technology (IT) particularly business to business (B2B) enabling technologies with your major suppliers. When answering this section please think of **a few major suppliers** whom you deal with directly. Please select one number to indicate the extent to which you agree with the statements listed below. Selecting 1 means Not at all and selecting 7 means All the time. You may select any of the numbers in between to indicate the strength of your agreement.

In my company …

Statement Ref.	**Electronic Integration: Information transfer for coordination of decision and operation integration, and managing transaction risk**	Not at all 1 : 2 : 3 : 4 : 5 : 6 : 7 All the time
1	We transmit purchase orders to our suppliers electronically	
2	We receive suppliers invoices electronically	
3	We make payments for the supplier's invoices electronically	
4	We exchange our sale (or production) data with our suppliers electronically	
5	We use the data, electronically transferred from the supplier, in our business decision	
6	The suppliers determine the order quantity for each item (based on sale data provided by us) and notify us electronically via a purchase order that the shipment is coming	
7	We share our promotion plans on the final products with our suppliers electronically	

8	We access our suppliers' shipping/delivery schedule electronically	1 : 2 : 3 : 4 : 5 : 6 : 7
9	We access our suppliers' inventory level of finished products/ raw materials electronically	1 : 2 : 3 : 4 : 5 : 6 : 7
10	We can electronically search for alternative suppliers for the product our suppliers provide	1 : 2 : 3 : 4 : 5 : 6 : 7
11	We can monitor the order status with a supplier electronically	1 : 2 : 3 : 4 : 5 : 6 : 7

SECTION 1.2

Human IT resources: The following situation describes your employee technical skills and managerial knowledge in relation to using IT (B2B enabling) technologies. Please select one number to indicate the extent to which you agree with the statements listed below. Selecting 1 means that you Strongly Disagree and selecting 7 means that you Strongly Agree. You may select any of the numbers in between to indicate the strength of your agreement.

In my company…

Statement Ref.	**Managerial knowledge and technical skills**	Strongly Disagree Strongly Agree
12	The technical skills of our employees exceed our main competitors	1 : 2 : 3 : 4 : 5 : 6 : 7
13	Our IT and system development group has the capability to work with the latest technology and tools available	1 : 2 : 3 : 4 : 5 : 6 : 7
14	Our IT managers understand our key business processes/ strategy	1 : 2 : 3 : 4 : 5 : 6 : 7
15	There is common understating between our IT group and other departments (e.g. logistics/supply chain managers) regarding how IT can be used to improve process performance	1 : 2 : 3 : 4 : 5 : 6 : 7

SECTION 1.3

IT complementary organisational resources: The following situation describes your organisational resources which are complementary IT (B2B enabling technology) resources. Please select the appropriate number to indicate the extent to which you agree or disagree with each statement as applicable to your company's situation.

In my company …

Statement Ref.	**IT integration**	Strongly Disagree Strongly Agree
16	Our IT planning is integrated with our overall business planning	1 : 2 : 3 : 4 : 5 : 6 : 7
17	Our company has a formal, long-term strategic plan for IT	1 : 2 : 3 : 4 : 5 : 6 : 7
18	We regularly measure the bottom-line effectiveness of our IT investment	1 : 2 : 3 : 4 : 5 : 6 : 7
Statement Ref.	**Chief executive - level of IT commitment**	Strongly Disagree Strongly Agree
19	Our CEO (top level management) often gets personally involved in matters relating to the use of IT with our supply chain partners.	1 : 2 : 3 : 4 : 5 : 6 : 7
20	Our CEO endorses major IT spending that has not been endorsed by traditional justification criteria and procedures	1 : 2 : 3 : 4 : 5 : 6 : 7
21	Our CEO views IT as a strategic instrument rather than an expense to be controlled	1 : 2 : 3 : 4 : 5 : 6 : 7
Statement Ref.	**Customer orientation**	Strongly Disagree Strongly Agree
22	Our business objectives are driven by customer satisfaction	1 : 2 : 3 : 4 : 5 : 6 : 7
23	We closely monitor and assess our level of commitment in serving customers' needs	1 : 2 : 3 : 4 : 5 : 6 : 7
24	Our competitive advantage is based on understanding customers' needs	1 : 2 : 3 : 4 : 5 : 6 : 7

25	Business strategies are driven by the goal of increasing customer value	1 : 2 : 3 : 4 : 5 : 6 : 7

SECTION 2

Supply chain channels capabilities: The following situation describes the ability of a company to identify, utilize, and assimilate both internal and external resources/information to facilitate the entire supply chain activities. When answering this section please think of **a few key suppliers and customers** whom you deal with directly as your company's partners. The statements below indicate your company's supply chain activities as compared to the nearest competitors in your type of business. Please select the appropriate number to indicate the extent to which you agree or disagree with each statement as applicable to your company's situation.

Statement Ref.	**Information sharing (e.g. decisions and demands, forecast knowledge, inventory level, etc.)**	Strongly Disagree Strongly Agree
26	My company exchanges more information with our partners than our competitors do with their partners	1 : 2 : 3 : 4 : 5 : 6 : 7
27	Information flows more freely between my company and our partners than between our competitors and their partners	1 : 2 : 3 : 4 : 5 : 6 : 7
28	My company benefits more from information sharing with our partners than do our competitors from their partners	1 : 2 : 3 : 4 : 5 : 6 : 7
Statement Ref.	**Supply chain coordination (e.g. quantity discount, returns policy, allocation rules, collaborative planning, forecasting and replenishment, etc.)**	Strongly Disagree Strongly Agree
29	My company is more efficient in coordination activities with our partners than are our competitors with theirs	1 : 2 : 3 : 4 : 5 : 6 : 7
30	My company spends less time coordination transaction with our partners than our competitors with theirs	1 : 2 : 3 : 4 : 5 : 6 : 7
31	My company has lower coordinating costs with our partners as compared to our competitors	1 : 2 : 3 : 4 : 5 : 6 : 7

Statement Ref.	**Supply chain responsiveness**	Strongly Disagree Strongly Agree
32	Compared to our competitors, our supply chain responds more quickly and effectively to changing customer and supplier needs (e.g. change products volume and mix, on time delivery, etc.)	1 : 2 : 3 : 4 : 5 : 6 : 7
33	Compared to our competitors, our supply chain responds more quickly and effectively to changing competitor strategies	1 : 2 : 3 : 4 : 5 : 6 : 7
34	The relationship with our partners has increased our supply chain responsiveness to market changes (e.g. new products) through collaboration	1 : 2 : 3 : 4 : 5 : 6 : 7

SECTION 3

Firm performance: The following statements measure overall performance of your company (market and financial performance). When answering this section please think of a few major competitors in your type of business. Selecting 1 means the performance is Unsatisfactory and selecting 7 means that the performance is Excellent. You may select any of the numbers in between to indicate the extent of your agreement.

Statement Ref.	**Financial performance**	Unsatisfactory Excellent
35	My company performs better than our major competitors in overall profitability	1 : 2 : 3 : 4 : 5 : 6 : 7
36	My company performs better than our major competitors in return on investment (ROI)	1 : 2 : 3 : 4 : 5 : 6 : 7
37	My company performs better than our major competitors in total cost reduction	1 : 2 : 3 : 4 : 5 : 6 : 7
38	My company performs better than our major competitors in cash flow from operations	1 : 2 : 3 : 4 : 5 : 6 : 7
Statement Ref.	**Market performance**	Unsatisfactory Excellent
39	My company performs better than our major competitors in average annual sales growth (over the past three years)	1 : 2 : 3 : 4 : 5 : 6 : 7
40	My company performs better than our major competitors in market share	1 : 2 : 3 : 4 : 5 : 6 : 7
41	My company performs better than our major competitors in market development	1 : 2 : 3 : 4 : 5 : 6 : 7
42	My company performs better than our major competitors in overall customer service level	1 : 2 : 3 : 4 : 5 : 6 : 7

SECTION 4

Your organisational characteristics: The following questions are for classification purposes only. In this section you may select more than one item as applicable to your company.

1. **Which of the following business to business enabling technologies does your company currently use in relation to your supply chain partners?**

- Electronic mail system and Internet
- Website for providing products and services information (e.g. catalogue of products, prices, online sale from products, etc.)
- Website for conducting transactions (e.g. financial transactions)
- Extranet (secure extension of an Intranet that allows external users to access some parts of an organisation's Intranet by using a password)
- Enterprise Resource Planning (ERP) systems (e.g. SAP, Oracle)
- Electronic data interchange (EDI/XML) capability
- Barcoding and Standards numbering technology
- RFID technologies

2. **Which of the following GS1 Australia (formerly EAN Australia) products and services does your company use to support your e-business activities?**

- GS1 Barcoding number and system (GTIN)
- GS1 system (e.g. e-messaging standards)
- GS1 Data synchornization
- GS1 electronic product code (EPC) standards for RFID technology
- GS1 dataBar
- GS1 net
- GS1 education and training

3. Please indicate the number of employees in your company:

- 1 to 50
- 51 to 100
- 101 to 250
- 251 to 500
- 501 to 1000
- 1001 to 5000
- 5001 to 10000
- Over 10000

4. Please indicate the average annual sales of your company in millions/ billions of AUD $:

- Under 5 million
- 5 to 10 million
- 10 to 25 million
- 25 to 50 million
- 50 to 100 million
- 101 to 499 million
- 500 to 999 million
- 1 to 4.99 billion
- Over 5 billion

5. Please indicate your industry sector

- Automobile
- Computer and communication
- Consumer products
- Chemical
- Electronic equipment
- Industry machinery
- Medical equipment
- Other (please indicate) _____

6. Please indicate the type of your company's role in the supply chain

- Raw material supplier
- Assembler
- Manufacturer
- Component supplier
- Sub-assembler
- Distributor
- Wholesaler
- Retailer

7. Please indicate your present job function

- Corporate executive
- Procurement/Purchasing
- Transportation
- Manufacturing production
- Distribution
- Sales & Marketing
- Other (please indicate) _____

8. Your job title

- CEO/president
- Director
- Manager
- Other (please indicate) _____

THANK YOU SO MUCH FOR YOUR TIME. IT IS VERY MUCH APPRECIATED.

Appendix 8: Letter of ethics approval

Dr Antonio Lobo FBE Mr Faraz Bidar
Approved Duration: 19/01/2009 to 20/11/2009

I am pleased to advise that the Chair of SHESC3 (or delegated member) has approved the revisions and clarification as emailed by you on 23/12/2008 in response to previous communication (SHESC email 19/11/2008). Unless otherwise notified, human research activity in the project may commence in line with standard or any special conditions for on-going ethics clearance.

The standard conditions for ethics clearance include the following:

- All human research activity undertaken under Swinburne auspices must conform to Swinburne and external regulatory standards, including the current National Statement on Ethical Conduct in Research Involving Humans and with respect to secure data use, retention and disposal.

- The named Swinburne Chief Investigator/Supervisor remains responsible for any personnel appointed to or associated with the project being made aware of ethics clearance conditions, including research and consent procedures or instruments approved. Any change in chief investigator/supervisor requires timely notification and SUHREC endorsement.

- The above project has been approved as submitted for ethical review by or on behalf of SUHREC. Amendments to approved procedures or instruments ordinarily require prior ethical appraisal/ clearance. SUHREC must be notified immediately or as soon as possible thereafter of (a) any serious or unexpected adverse effects on participants and any redress measures; (b) proposed changes in protocols; and (c) unforeseen events which might affect continued ethical acceptability of the project.

- At a minimum, an annual report on the progress of the project is required as well as at the conclusion (or abandonment) of the project.

- A duly authorised external or internal audit of the project can be undertaken at any time.

Please contact me if you have any queries or concerns about on-going ethics clearance. The SUHREC project number should be cited in communication.

Best wishes with the project.

Yours sincerely

Anne Cain
Secretary, SHESC3
Swinburne University of Technology
FBE Research Office -H95
Level 6, 60 William St
Hawthorn 3122

Publications associated with this thesis

Bidar, F. & Lobo, A. 2010, "Development of a Framework for Electronically-enabled Supply Chains: Channel Relationships and Firm Performance", 8th ANZAM Operations, Supply Chain and Services Management Symposium, Sydney.

Bidar, F., Lobo, A. & Hill, R. 2009, "Leveraging Digitally Supply Chain Integration Capabilities to Enhance Organizational Performance and Competitive Advantage", International Conference on e-Business (ICE-B), Milan, Italy.