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# Supply Chain Integration Operational Issues: Impact on Supplier Commercial Relationships and Order Fulfilment in New Zealand Public Hospitals

Kabossa A.B. Msimangira
Department of Management
School of Business
Auckland University of Technology
Private Bag 92006
Auckland 1020
New Zealand

Phone: + 64 9 918 4655

E-mail:Kabossa.msimangira@openpolytechnic.ac.nz

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**Abstract**

Academics and practitioners acknowledge that supply chain integration (SCI), supplier commercial relationships (SCR), and order fulfilment (OF) are key areas for reducing operational costs and improving service level to meet customers' requirements. Nevertheless, little is known concerning supply chain integration operational issues and their impact on SCR and OF in public hospitals. This paper reports the critical SCI operational factors and their impact on SCR and OF from a study conducted in New Zealand public hospitals. A survey methodology was used to collect data. The findings and suggestions to improve SCI in public hospitals are discussed.

**Keywords**: supply chain integration, supplier relationships, order fulfilment, public hospitals, New Zealand.

## 1.0 Introduction

The objective of this research is to understand the critical supply chain integration operational factors and their impact on supplier commercial relationships and order fulfilment in New Zealand (NZ) public hospitals.

Many people, including academics and practitioners have developed an interest in supply chain management (SCM) and supply chain integration (SCI). The practitioners are using SCM and SCI knowledge in order to reduce operational costs and to improve customer service in a global competitive environment. In addition, practitioners have been using SCM and SCI to reduce inefficiencies in their current management processes.

Lambert, Cooper, and Pagh, (1998, p. 1) define SCM as the "integration of business processes from end user through original suppliers that provides products, services, and information that add value for customers." Handfield and Nichols (2002, p. 8) define SCM as "the integration and management of supply chain organizations and

activities through cooperative organizational relationships, effective business processes, and high levels of information sharing to create high – performing value systems that provide member organizations a sustainable competitive advantage."

The National Research Council in the U.S. (2000, p. 27) defines an integrated supply chain as an association of customers and suppliers (supply chain stakeholders) who, in using management techniques, work together to optimize their collective performance in the creation, distribution, and support of an end product manufacturer.

Kim and Narasimhan (2002) argue that supply chain integration links an organisation with its customers, suppliers, and other channel members by integrating their relationships, activities, functions, processes and locations. Supply chain integration is a good approach for improving business performance in a highly competitive market (Narasimhan, Jayaram, & Carter, 2001). Although there is general understanding on the strategic importance of supply chain integration (Cooper, Lambert, & Pagh, 1997; Handfield & Nichols, 1999), Frohlich and Westbrook (2001) claim that little is known regarding the relationship between SCI and its impact on performance.

Lambert (2004) states that executives in many companies face problems to achieve the required integration because they don't fully understand the supply chain business processes and linkages needed to integrate eight key SCM processes identified by members of The Global Supply Chain Forum. The eight processes used in the process - based management theory (approach) are: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationships management, product development and commercialization, and returns management (Lambert, 2004). A supply chain (SC) is a network of members and links between the members (Lambert, Cooper, & Pagh, 1998). Handfield and Nichols (2002, p. 8) state that the SC involves activities associated with the flow and transformation of goods from the raw materials stage (extraction), through to the end user, as well as the associated information flows. However, Mentzer, DeWitt, Keebler, Min, Nix, Smith and Zacharia (2001) limit their definition of a supply chain to the flow of products, services, finances, and/or information from a source to a customer, whereas Lambert et al. see a two way flow

of information. Basu and Wright (2008) add to physical flow of goods and flow of information the flow of funds to certain types of supply chains such as those found with point of sale retail operations. Management of the SC is, therefore, basically the management of the relationships and activities among the members of organisations (system).

Supply chain management (SCM) links a firm with its customers, suppliers and other members of the supply chain system, including logistics and warehousing companies. The goal of SCM is for members in the organisations to integrate, work together, and build a partnership with each other to increase the competitive advantage of the supply chain as a whole (Mentzer et al. 2001).

Bowersox, Closs and Stank (1999) have classified integration in the supply chain context into six different types: customer integration, internal integration, material and service supplier integration, technology and planning integration, measurement integration, and relationship integration. SCM literature has emphasized the importance of SCI in creating value and reducing costs (e.g., Lee, 2000; Lee & Wolfe, 2003) and the cost of logistics in the supply chain (Delaney, 2000).

Studies of SCM/SCI issues in the health sector are scarce in the literature. For example,Task Force Report on Supply Chain Management (2001), a joint initiative of the Ontario Hospital Association of Canada, which found that an efficient SC could reduce cost; Breen and Crawford (2005) state that e-commerce is an important aspect of SCM; Towill and Christopher (2005) emphasize the use of principles of SC design in healthcare; and Okoroh, Gombera and Ilozor (2002) stress that healthcare facilities management is part of the service chain process. In addition, the literature provides researchers who studied supply chain integration in hospitals (e.g., Zheng et al., 2006; Bagchi & Chun, 2005; Byrnes, 2004; Novelli, 2004; Hersch & Pettigrew, 2002; McGrath & More, 2001; Harland, 1996),

Although there is general understanding on the importance of supply chain integration, little is known regarding SCI operational issues and their impact on supplier commercial relationships and order fulfilment in public hospitals. This paper reports the findings of the research to fill this gap in the literature.

This study aims to answer the following research questions:

1. What are the critical operational factors influencing supply chain integration in NZ public hospital sector?

2. What is the impact of critical operational factors affecting the supply chain integration on supplier commercial relationships and order fulfilment in NZ public hospital sector?

3. How can the public hospital sector enhance supply chain integration to improve supplier commercial relationships and to achieve the order fulfilment goals?

4. What are barriers to SCI practices in public hospitals?

This paper is organised as follows: introduction; literature review; conceptual model and hypotheses; survey methodology research; analysis; recommendations to enhance SCI in the public hospitals; and discussion of the results, study limitations, conclusions, and directions for future research.

### 1.1 Supply chain in the public hospital sector in New Zealand

The Public Health and Disability Act 2000, implemented in 2001 established the District Health Boards (DHB) in NZ. There are 21 DHBs and 40 public hospitals in NZ providing services to 4.2 million people . DHBs are "responsible for providing, or funding the provision of health and disability services in their district" (Ministry of Health in NZ, 2008). A high level of operating deficit across the sector (e.g., NZ $185 million in mid 2003) creates difficulties for DHBs as they try to manage and reduce these deficits, to increase the funding of a wider range of community services (Dew and Davis, 2005), and to lower operational costs, especially the cost of procurement in the public hospitals and other health service providers. More

specifically, DHBs had deficits in 2005 of up to NZ $58,110,000 (down from $185, 000, 000 in 2003), and all had high levels of inventory.

High levels of inventory indicate that money is tied up in inventory and they contribute to the deficits, which reduce money available to meet other obligations. Furthermore, high levels of inventory show that the supply is not well integrated to reduce inventory and costs. Though the problem is recognisable, no research on supply in public hospitals exists in NZ.

The initial investigation on supply chain in public hospitals reveals three types of supply chain networks (Figure 1.0):

(1) DHBs buy products and services from various suppliers in order to fulfil the requirements of the hospitals and health service providers (customers tier 1), and doctors, nurses, patients, and offices (customers tier 2);

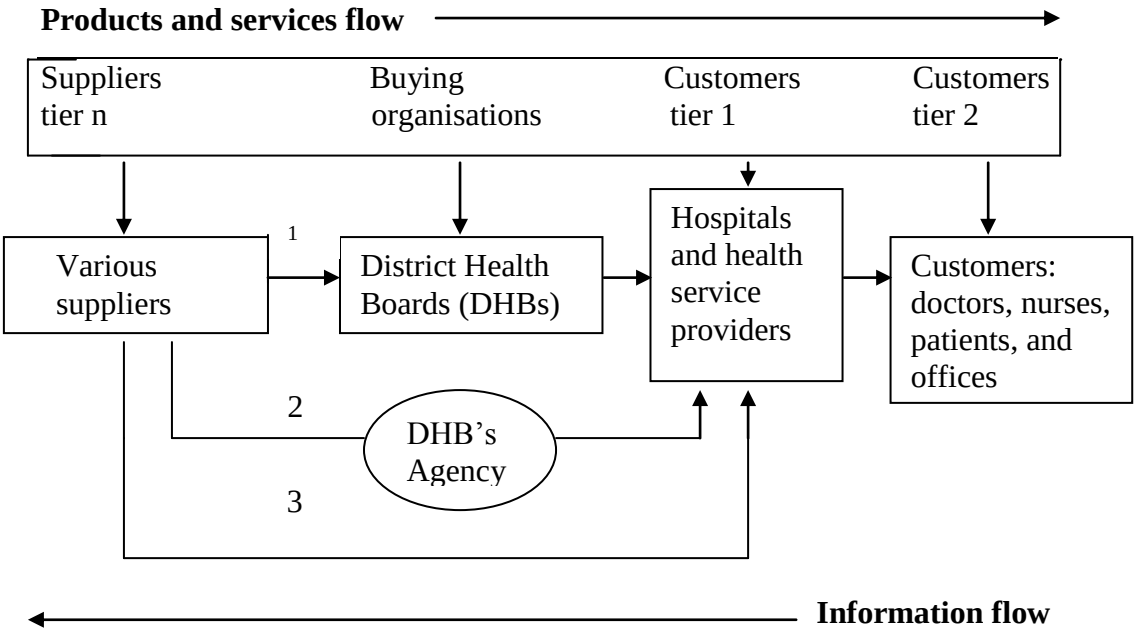
(2) DHB's Agency buys products and services from various suppliers in order to meet the requirements of the customers tier 1; and

(3) Hospitals and health service providers buy products and services direct from various suppliers in order to meet the requirements of the customers tier 2.

The model of supply chain for buying products and services in the public health sector in NZ is indicated in Figure 2 (Middlemore hospital, 2006).

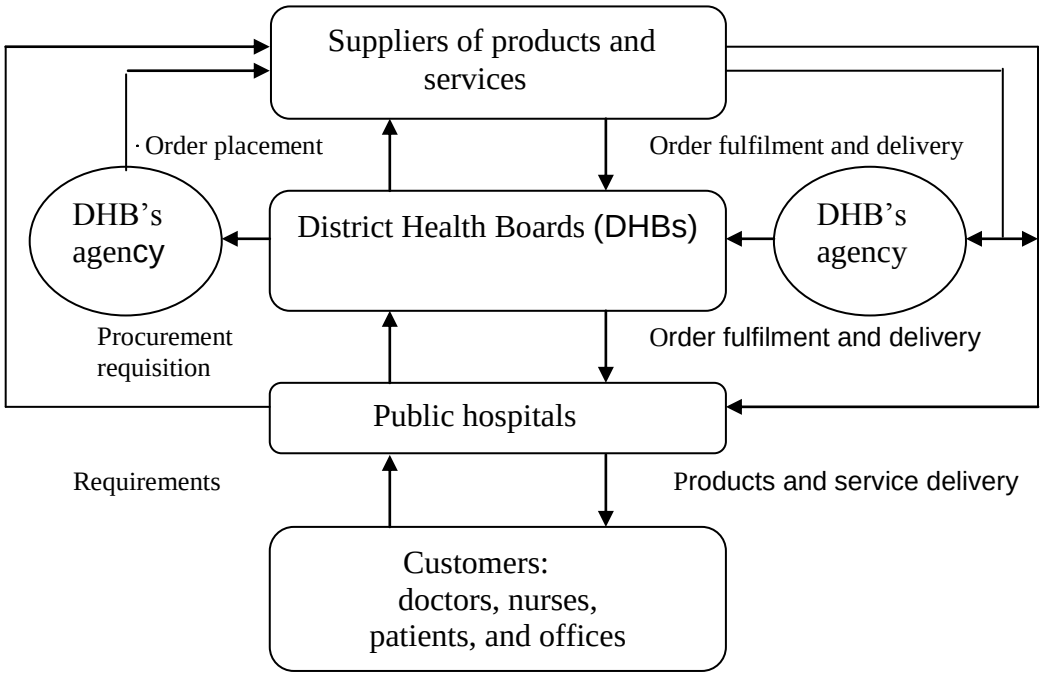
After reviewing the existing SC in NZ public health sector, it shows that SC is not standardised, and hospitals have different ways of meeting their procurement needs. Hospitals get their requirements through an agency or direct from the suppliers.

**Figure 1.0: Products and services supply chain network in public health sector in New Zealand**




Source: Author

**Figure 2.0: Model of the supply chain for products and services in the public health sector of New Zealand**




Source: Author

## 2.0 Literature review

### 2.1 Supply chain integration

Many definitions of SCI provided in the literature create confusion to the practitioners and academics. For the purpose of this study, the definition used is that of the National Research Council in the U.S.

The National Research Council (2000, p. 27) defines an integrated supply chain as an association of customers and suppliers (supply chain stakeholders) who, using management techniques, work together to optimize their collective performance in the creation, distribution, and support of an end product manufacturer. Thus, SCI is a continuous process that can be optimized only when the original equipment manufacturers (OEMs), customers, and suppliers work together in partnership to improve their relationships and when all participants are aware of key activities at all levels in the chain (National Research Council, 2000). Supply chain integration is the level to which all activities in an organisation and that of its suppliers, customers, and other supply chain members are integrated (Stock & Tatikonda, 2000; Narasimhan and Jayaram, 1998; Li, 2002; Marquez, Bianchi & Gupta, 2004). Kim and Narasimhan (2002) state that supply chain integration links an organisation with its customers, suppliers, and other channel members by integrating their relationships, activities functions, processes and locations.

Hill and Scudder (2002) emphasise on inter-organisational coordination in the supply chain to integrate activities. Organisations must integrate their operations with trading partners in order to sustain competitive advantage for the whole supply chain (Cox, 1999; Lambert and Cooper, 2000). The literature on supply chain integration is composed of three types of integration: integration with suppliers, integration with customers, and internal integration across supply chain (Frohlich & Westbrook, 2002; Frohlich, 2002; Narasimhan & Kim, 2002).

Supply chain integration is considered a suitable approach for improving business performance in highly competitive market (Narasimhan, Jayaram & Carter, 2001). Furthermore, Yusuf, Gunasekaran, Adele and Sivayoganathan (2004) stress that SCI

is a vital tool for competitive advantage, and they support Lee and Whang (1999) on the importance of SCI.

The importance of SCI has been recognized in the literature (e.g., Lee & Whang,1999). Integration is emphasised by the Supply Chain Council's supply chain operations reference (SCOR) model. SCOR is a management tool that "enables users to address, improve, and communicate supply chain management practices within and between all interested parties. It is a process reference model for supply chain management, spanning from the supplier's supplier to the customer's customer" (Supply Chain Council, n.d., 2001). The SCOR Model is a cross industry framework for the evaluation and improvement of supply chain management and performance (Stewart, 1997). The model have five major supply chain processes: plan, source, make, deliver and return. The source process of the SCOR model comprises managing incoming raw materials, supplier selection and certification, supplier relationships and agreements (Stephens, 2001; Stewart, 1997). The deliver process deals with all warehousing, distribution and logistics processes and decisions that impact the delivery of product to the customer, including customer order entry and management, warehouse picking and distribution, invoicing and selection of carriers (Stephens, 2001 & Stewart, 1997).

Frohlich and Westbrook (2001) found that the highest levels of integration with both suppliers and customers had the highest correlation with high levels of an organisation's performance. Furthermore, Frohlich and Westbrook (2002) reported that firms that embrace high levels of internet-based supply integration and demand integration experience the highest levels of performance. Rosenzweig, Roth & Dean (2003) support the findings of Frohlich and Westbrook (2001) that supply chain intensity leads to improved business performance. Zailani and Rajagopal (2005, p. 379) add that the potential benefits of integrating the supply chain "will be realised only if the interrelationships among different parts of the supply chain are recognized, and proper alignment is ensured between the design and execution of the company's competitive strategy." Lack of integration between members of supply chain results in operational inefficiencies and hinders the performance of the supply chain.

Estimates of European companies' supply chains highlighted that only 10% of supply chains are well integrated (Towill, Childerhouse & Disney, 2000). Simchi-Levi et al. (2003, p. 10) provide three examples of companies implementing supply chain and state that "the National Semiconductor, Wal-Mart, and Procter & Gamble success stories demonstrate not only that integrating the supply chain is possible, but it can have a huge impact on the company's performance and market share." Lee (2000) argues that a truly integrated supply chain contributes more than reduced costs, and emphasizes the added value (e.g., sharing information resulting in savings, higher profit margins, improved customer service performance, and shareholder values are multiplied) for the company, supply chain partners and shareholders. In a study of the performance benefits of supply chain logistical integration, Stank, Keller, and Closs (2001) found that SCI creates value through improved customer service levels and reduced costs. The National Research Council (2000, p.33) state that "the most sought-after benefit, or return on investment, in supply chain integration is the cost savings that result from reductions in inventory. Inventories can be reduced by increasing the speed at which materials move through the supply chain and by reducing safety stocks."

Hammer (2001) presents examples of Geon, Hewlett-Packard (HP), and General Mills that have successfully integrated their operations with those of their suppliers. For example, the Geon's processes integrated are: Geon's customer's procurement process, Geon's order fulfilment and procurement processes, and Geon's supplier's order fulfilment process.

## 2.2 SCI operational issues

The success of an organisation regarding SCI depends on how management critically examines the SCI operational issues, which are likely to affect an organisation's ability to successfully implement SCI.

SCI operational issues are concerned with the organisation's activities that can have impact on enhancing SCI in an organisation. Barki and Pinsonneault (2005, p. 165) propose the concept of organisational integration, which is defined as "the extent to

which distinct and interdependent organisational components constitute a unified whole" and they identified two intraorganisational integration: (1) internal-operational (integration of successive stages within the primary process chain (workflow) of an organisation) and (2) internal-functional (integration of administrative or support activities of the process chain of an organisation. Akkermans, Bogerd, Yucesan, and Wassenhove (2003) found that the executives expected further integration of activities between suppliers and customers across the entire supply.

The operational SCI issues, such as SCI initiatives, organisation strategy and SCI drivers, performance improvement and SCI, organisational environmental forces, and barriers to SCI, are discussed in the following sections.

### 2.2.1 Supply chain integration initiatives

Braganza (2002) argues that enterprise integration initiatives are not equally important and they differ by their purpose. Enterprise integration initiatives are based on the capabilities developed for an organisation. Filippini, Forza, and Vinelli (1996; 1998) stress that external competitive pressure appears to influence the number of initiatives that companies implement. They found that there is a relationship between the level of competitiveness in the external situation and the more about innovation. Corbett and Van Wassenhove (1993) also argue that a company should start the initiatives with the aim of achieving a certain level of performance "compartible with qualifying and order winning criteria in the competitive contex" (Corbett & Van Wassenhove, 1993, p. 107).

Lack of external fit acts as a cause for companies to implement SCM/SCI initiatives (Danese, Romano, & Vinelli, 2006). They found that "external fit influencies the type of SCM initiatives to be launched as companies select them on the basis of those performance dimensions to be improved." For example, "if managers believe that the company performance level fitted the performance conditions for competitiveness there is no plans to implement any new SCM initiative" (Danese, et al., 2006, p. 1210). Donk and Akkerman (2008) support the results of Danese et al. (2006). They claim that "uncertainties and complex business conditions increase the need for integration" (Donk & Akkerman, 2008, p. 218).

Rai, Patnayakuni, and Seth (2006) found that integrated information technology infrastructures enable a firm to develop the higher-order capacity of supply chain process integration. In addition, they emphasised that "managerial initiatives should be directed at developing an integrated IT infrastructure and leveraging it to create process capabilities for the integration of resource flows between a firm and its supply chain partners." (Rai et al., 2006, p. 225).

In order to understand the nature of SCM as it is practices, Fawcett and Magnan (2002) sought experience and insight of industry managers engaged in SCI initiatives. They found that supply chain integration practice does not always resemble the theoretical principle and emphasised that "managers must recognize the tension that exists between SCM's competitive potential and inherent difficulty of collaboration" (Fawcett & Magnan, 2002, p. 339). Fawcett and Magnan (2001, p. 11) found a strong functional bias in the data. "Each functional area viewed itself as very supportive of SCM while identifying the other functional areas as less engaged or even obstructive."

### 2.2.2 Organisation strategy and SCI drivers

Strategy is "concerned with the long-term direction of an organisation" (Johnson & Scholes, 2002, p. 4). Raps (2005, p. 141 ) claim that "the key to success is an integrative view of the implementation process" of the strategy. Researchers have emphasised the strategic importance of integrating suppliers, manufacturers, and customers (e.g., Lummus, Krumwiede, & Vokurka, 2001; Van Hoek, Harrison, & Christopher, 2001; Lowson, 2003; Barratt & Oliveira, 2001; Barratt, 2004). Furthermore, Martensen and Dahlgaard (1999) stress on the importance of linking an innovative strategy to the company's vision and overall business strategy. Briscoe, Dainty, Millett, and Neale (2004, p. 193) found that "clients are shown to be key drivers of performance improvement and innovation and are the most significant factor in achieving integration in the supply chain." Briscoe's findings are similar to that of Fawcett and Magnan (2001) who found improving customer satisfaction as the dominant motivation to SCI.

Morash (2001) reports that supply chain capabilities are the building blocks for supply chain strategy and a source of competitive capability for an organisation's success.

Dangayach and Deshmukh (2001) also assert that those organisations that can manage their capabilities and resources related to SCM more efficiently are likely to gain competitive capabilities and superior performance leading to increased competitiveness. "The role and benefit of SCI as a strategic lever for the interactive relationship between corporate competitive capability and SC operational capability can be different depending on the developmental stage of SC integration" (Stevens, 1990; Narasimhan and Jayaram, 1998). Stevens (1990) points out that "as the stage of integration moves from independent operation and functional integration to internal and external integration, the focus of corporate capabilities would shift from operational and tactical to strategic aspects" (Stevens, 1990, p. 1085).

### 2.2.3 Performance improvement and SCI

Kim (2006, p. 241) conducted a study on effects of SCM practices, integration, and competition capability on performance, found that "in small firms, efficient SC integration may play a more critical role for sustainable performance improvement, while, in large firms, the close interrelationship between the level of SCM practices and competition capability may have more significant effect on performance improvement. In addition, "once SCI has been implemented, it may be advisable to focus on SCM practice and competition capability" (Kim, 2006, p. 241). In the empirical study on the effect of SCI on alignment between corporate competitive capability and SC operational capability, it was found that "the effect of integration between corporate competitive capability and SC operational capability on performance improvement becomes insignificant as the developmental stage of SC integration increases" (Kim, 2006, p. 1084).

Briscoe et al.(2004) found that clients are key drivers of performance improvement and innovation, and they are the most significant factor in attaining integration in the SC. However, Frohlich and Westbrook (2001, p. 185) concluded that "there was consistent evidence that the widest degree of arc of integration with both suppliers and customers had the strongest association with performance improvement." Stratman (2007, p. 203) propose that organisations that are "seeking external market and supply chain performance improvements must first establish a foundation of internal operational performance improvement before customer satisfaction and supply chain

benefits can be realized." Sundarraj and Talluri (2003) stress that sharing and coordination of information across the SC at the right time, are major factors to improving the performance of an organisation. Fawcett and Magnan (2001) identified four highest-ranked benefits: responsiveness to customer requests, on-time delivery, overall customer satisfaction, and order fulfilment lead times, which are key to performance improvement.

### 2.2.4 Organisation environmental forces

Daft (2000, p. 73) defines organisational environment as "all elements existing outside the organization's boundaries that have the potential to affect the organisation." The external organisational environment is composed of competitors, resources, technology, and economic conditions that have an impact on the organisation (Daft 2000). Mullins (2002) explains further the environmental influences on the organisation, for example, competitors, suppliers, economic activity, social attitudes, customers, culture, shareholders or providers of finance, and technological innovations that are constanty changing. "In order to understand the operations of organisations, and to improve organisational performance, it is necessary to consider how they achieve an internal and external balance and how they are able to adopt to changes in their environment and the demand placed upon them (Mullins, 2002, p. 110).

Fawcett and Magnan (2001) found that the desire to improve customer satisfaction is the key factor among the environmental forces to SCI followed by improving SC productivity, intensifying competition, an opportunity to build the best team of SC partners, compete against global supply chains, focus on competence in services, customers initiated integration, access to global markets, shifting channel power, and suppliers initiated integration.

### 2.2.5 Barriers to SCI

The benefits of SCI have been known to practitioners and academics but the implementation of SCI in practice has been difficult. SCI provides vital competitive advantage, such as ability to 'outperform' rivals on both price and delivery (Lee &

Billington, 1992). The higher the level of integration the greater the benefits (Narasimhan & Jayaram, 1998; Frohlich & Westbrook, 2001; Ahmad & Schroeder, 2001). However, researchers have found barriers to SCI. For example, Christopher and Ryals (1999) found that the key barriers to time shortening in the supply chain are the long replenishment lead-times often experienced with suppliers.
Members of supply chain (e.g., suppliers, manufacturers, and customers) can be a barrier to change operations, and they frequently compete for the power to control the supply chain (Cox, Sanderson, & Watson, 2001). Frohlich (2002, p. 550) found that "managers interesting in improving their company's supply chain using e-integration should first focus on internal barriers" and concludes that internal barriers hinder "e-integration more than either upstream suppliers or downstream customer barriers" (Frohlich, 2002, p. 537). Halldorsson, Larson, and Poist (2008) also found that internal resistance is more of a barrier than external (customer or supplier) resistance to SCM.

Barratt (2004) found that lack of visibility of demand and inventory holding status across the supply chain, together with adversarial relationships between trading partners are critical barriers to SCI. Daintly, Briscoe, and Millett (2001, p. 163) revealed that barriers to supplier integration are due to "skepticism over the motives behind supply chain management practices." Van der Vaart and Van Donk (2004, p. 21) claim that "the goal of integrated supply chains is to remove barriers to ease the flow of materials and information." Shared resources is a key barrier to supply chain integration (Van der Vaart & Van Donk, 2004). Van Donk, Akkerman, and Van der Vaart (2008) also argue that there are limits to integrating supplier's operations to that of customers.

Frohlich (2002) classifies supply chain integration barriers in three categories: (1) supplier barriers, (2) internal barriers, and (3) customer barriers on technology costs/benefits not demonstrated; existing business model/current practice; and lack of technical/e-business skills. Fawcett, Magnan, and McCarter (2008) identified the following top ten barriers to strategic suply chain management, which are also reflected in SCI in the literature (e.g., Fawcett & Magnan, 2001; Fawcett et al., 2002):

(a) Interfirm rivalry

- Inadequate information sharing
- Inconsistent operating goals
- Lack of willingness to share risks and rewards
- Lack of willingness to share information

(b) Managerial complexity

- Lack of alliance guidelines
- Processes poorly appraised in terms of costs
- Non-aligned measures
- Organizational boundaries
- Measuring supply chain contribution
- Measuring customer demand (Fawcett et al., 2008, p. 44).

## 2.3 Supplier commercial relationships

### 2.3.1 Commercial relationships

Lambert (2004, p. 21) define supplier relationship management (SRM) as the process that "provides the structure for how relationships with suppliers are developed and maintained." Lambert emphasise that the firm should negotiate a product and service agreement (PSA) that defines the terms of the relationship for every key supplier and managing the PSAS (Lambert, 2004). There are two main extremes of commercial relationships described in the literature: the adversarial relationship (an extreme form of 'arms length') and partnerships (Baily, Farmer, Jessop & Jones, 1998). The study conducted by Quayle (2003) revealed that a lack of effective change from traditional adversarial relationships to the modern collaborative "e" – supply chain in the organisations. There are many types of supplier relationships, but little is known regarding the critical supplier commercial relationships which affect SCI. Kwon and Suh (2005, p. 26) state that "Effective supply chain planning based on shared information and trust between and among partners is an essential element for successful supply chain implementation." Bowersox et al. (2000) also found in their study that effective information sharing is greatly dependent on trust in the SC members' relationships initially within the firm and finally extending to supply chain partners. La Londe (2002, p.10) further emphasizes that "issues of trust and risk can

be significantly more important in supply chain relationships, because supply chain relationships often involve a higher degree of interdependency between companies."

Given the importance of trust discussed above, a study conducted by Golicic, Davis, McCarthy and Mentzer (2002, p. 851) revealed that "a stronger emphasis on relationship management as part of business strategy enables managers to manage uncertainty better." They also discovered that "increased information does not decrease the perception of uncertainty."

Therefore, when the business environment becomes more complex, organisations realise that benefits can be achieved from closer, long-term relationships (Ganesan, 1994). Burt, Dobler and Starling (2003, pp. 86 - 87) stress that there is a need to establish the strategic essentials of a relationship, such as a collaborative relationship, trust, and flexibility and speed of responsiveness. Carr and Pearson (1999) expressed that buyer-supplier relationships have a positive impact on an organisations financial performance. The results of the study conducted by Cannon and Homburg (2001, p. 29) to investigate buyers-supplier relationships and customer firm costs show that "increased communication frequency, different firms of supplier accommodation and the geographic closeness of the supplier's facilities to the customer's buying location lower customer firm costs. In addition, customer firms intend to increase purchases from suppliers that provide value by lowering each of these costs." It is important to maintain business relationship with key suppliers.

Ulaga and Eggent (2006) in their study found that a key supplier status offers several advantages to vendors, for example, key suppliers normally gain larger share of a customer's business than other suppliers. Their study revealed that key suppliers secured 73.3 % of customers' order volumes while secondary suppliers gained only 19.5% of customers' requirements. Although the literature shows that there is a need to strenghten buyers and supplier relationships, a study conducted by Pan and Pokharel (2007, p. 195) in Singapore found that "hospitals do not see alliances with suppliers as a strategic option; rather they focus on outsourcing of logistics services."

### 2.3.2 Long-term relationships with key suppliers

According to Ragatz, Handfield, and Scannel (1997), effective integration of suppliers into supply chain will be a major factor for some manufacturers in attaining competitive advantage. Higher level of integration with suppliers and customers in supply chain, the greater the potential benefits (Frohlich & Westbrook, 2001; Narasimhan & Jayaram, 1998; Tan, Kannan, & Handfield, 1998). The study conducted by Tan, et al., (1998) on supplier performance and firm performance, confirms that a company's customer relations and purchasing practices can impact its financial and market performance. Lau and Goh (2005) propose that technological, social, time and actual distances, other than the quality of the relationships can affect relationship development. They suggest that buyers must consider cautiously the influence of the geographical proximity of suppliers. Buyers should use the services of people who understand the supplier's local culture (Lau & Goh, 2005). In addition, Jonsson and Zineldin (2003, p. 224) stress that "a good reputation, close relationship and positive relationship benefits are key variables for the achievement of high satisfaction in a 'high-trust and commitment relationship'."

Integration with suppliers emphasize on a long-term commitment among the collaborators, openness of communication, and common trust. Supplier partnering attempts to involve supplier's early in the product life cycle in activities, such as product design and acquisition of technological capabilities (Narasimhan & Das, 1999).

### 2.3.3 Supplier participation in planning and design

Supplier participation in planning and design depends on the level of collaboration with the customer/user. Collaboration is the process of working together in planning and decision making between members in the supply chain. Narus and Anderson (1996) define a collaborative supply chain as the cooperation among independent but related firms to share resources and capabilities to meet their customers' needs. The result of an empirical study conducted by Lin and Tseng (2006) to identify the pivotal role of participation strategies, and information technology application for supply chain excellence revealed that strategy planning plays an important role in achieving

organisational performance in implementing the supply chain system. This emphasises the strategic benefit of integrating operations with suppliers and customers in a supply chain system (Lin & Tseng, 2006).

## 2.4 Focused supply chain integration

SCI has many definitions in the literature but they are less focused on management behavioural issues. For this reason, the focused supply chain integration (focused SCI) construct has been created for this study. Focused SCI refers to the targeted management behavioural issues which can have impact on organisation's ability to integrate management processes and corporate culture practices in the hospitals.

Literature furnishes different dimensions of measuring SCI (e.g., benefits, barriers, and bridges (Fawcett et al., 2008); integration of eight key SCM processes (Lambert, 2008); content integration at the point of sale (Loebbecke, 2007); supplier integration activities (Wagner, 2003); integration with suppliers, integration with customers (Frohlich, 2002); supply chain alignment: benefits, barriers, and bridges (Fawcett, & Magnan, 2001); and integration of eight key SCM processes (Lambert et al., 1998a, 1998b).

It is evident from the literature that there are different dimensions of measuring SCI. This study will measure SCI using focused SCI measurements based on organisational management behavioural aspects. Focused SCI will be measured to determine critical management behavioural factors that enhance SCI in the hospitals.

The assumption is that improved focused SCI lead to improved operational SCI issues, commercial supplier relationships, and order fulfilment.

## 2.5 Order fulfilment

### 2.5.1 Order fulfilment process

The dependent variable for this study is order fulfilment.

The literature provides different dimensions of measuring order fulfilment. Lambert (2004, p. 21) defines order fulfilment as the supply chain process that "involves more than just filling orders. It also encompasses all activities necessary to define customer requirements, design a network, and enable a firm to meet customer requests while minimizing the total delivered cost. While much of the actual order fulfilment work will be performed by the logistics function, the process needs to be implemented cross-functionally and coordinated with key suppliers and customers."

Order fulfilment is one of supply chain activities in an organisation involving the supplier in meeting customer demand. The supplier capability in meeting the customer order requirement has an impact on customer service level. Palmatier (1988) emphasises the need for establishing closer links with customers in order to improve demand planning. The cost benefits obtained through such closer collaboration and information transparency are well documented in literature. Duffy and Dale (2002) state that order fulfilment is a major consideration for business to consumer (B2C) operations and it is one of the foremost critical success factors.

A study conducted by Kritchanchai and MacCarthy (1999, p. 830) to investigate the responsiveness of the order fulfilment process in a number of companies revealed that "it is clear that companies tend to be responsive with respect to their strategic directions and the key issues are then to determine the appropriate ways to respond and appropriate levels of responsiveness." They also indicated that there are few sources in the literature discussing the details of the order fulfilment process clearly, and recommended that the grouping of companies based on the characteristics of their order fulfilment processes be investigated more widely. A study conducted by Thirumalai and Sinha (2005) supports the findings of Kritchanchai and McCarthy (1999). They found that "customers tend to have higher satisfaction levels with the order fulfilment process of convenience and shopping goods than with the order fulfilment process of specialty goods" (Thirumalai & Sinha, 2005, p. 291). Similar results may be obtained in the health sector. Therefore, the differences in order fulfilment processes for various goods need to be studied.

### 2.5.2 Demand management - collaborative planning

Lambert (2004, p. 21) defines demand management as "the process that balances customer requirements with supply chain capabilities. With the right process in place, management can match supply with demand proactively and execute the plan with minimal disruptions." A major cause of supply chain inefficiency mentioned in the literature is the bullwhip effect (discussed in section 2.2.3). Demand variability increases when it moves from downstream to upstream in a supply chain and the bullwhip effect causes unnecessary inventory increase in the supply chain (Balan, Vrat & Kumar, 2007).

Balan et al. (2007) emphasize that there is a need to reduce "errors associated with forecasted demand between the nodes of a supply chain" and allow "a smooth information flow by reducing the vagueness in the chain" (Balan et al., 2007, p. 261). In addition, they argue that managers can forecast the demand with less distortion and improve the supply chain effectiveness, using human judgement on the errors and change in errors associated with forecasted demand (Balan et al., 2007). Lee, Padmanabhan and Whang (2004, p. 1875) state that "the information transferred in the form of "orders" tends to be distorted and can misguide upstream members in their inventory and production decisions."

The recognition of the value of information sharing between supply chain members has made many firms develop interest in jointly forecasting customer demand and co-managing business functions (Min & Yu, 2008). The implementation of collaborative planning, forecasting and replenishment (CPFR) aimed at improving collaboration between buyer and supplier has been successful in minimizing safety stocks, improving order fill rates, increasing sales, and reducing customer response time (Min & Yu, 2008). However, they claim that regardless of increasing popularity of CPFR, key drivers for the successful development and implementation of CPFR are not well grasped by practitioners and academicians (Min & Yu, 2008). "If demand information can be communicated throughout the entire supply chain each trading partner would know how much product to have available and when" (Crum & Palmatier, 2004). Crum and Palmatier (2004) identified the common reasons why demand collaboration has not realized its potential:

- The pace of adopting new ways of doing business is slow
- Demand information supplied by customers is not put to use in trading partners' own demand, supply, logistics, and corporate planning in an integrated manner
- Demand management and supply management processes are not integrated, and sales and operating planning is not utilized to synchronize demand and supply
- Lack of trust among trading partners to share pertinent information and collaborate on decision making.
- The desire to partner but not commit to executing the communicated plans
- A common view that demand collaboration is a technology solution and that the current technology is too complex (Crum and Palmatier, 2004).

### 2.5.3 Inventory management in supply chain

Managing inventory in the supply chain is essential to secure higher customer service levels. Inventory is a very costly asset to keep because of the the following costs: e.g., storage facilities, handling, insurance, pilferage, breakage, obsolescence - used by date, interest, wastage, and cost of capital. Having the right amount of inventory to meet customer requirements is critical (Logistics Bureau, 2007). Many researchers in the literature assert that the focus point of successful supply chain management is inventories and inventory control (Dooley, 2005). Food manufacturers and grocers in 1992 created efficient consumer response to shift their focus from controlling logistical costs to examining supply chains (King & Phumpiu, 1996). The general understanding and experience is that supply chain management leads to cost savings, largely through reductions in inventory. Inventory costs decreased by about 60% since 1982, while transportation costs have decreased by 20% (Wilson, 2004). Dooley (2005) argue that cost savings motivated many organisations to engage in inventory-reduction strategies in the supply chain. However, in order to develop the

most effective logistical strategy, an organisation must understand the nature of product demand, inventory costs, and supply chain capabilities (Dooley, 2005).

Furthermore, Dooley (2005) emphasise that supply chain coordination can reduce the uncertainty of product demand, and hence, decrease inventory costs. Hanna, Groot, Loo, and Ypenburg (2003); Viswanathan and Piplani (2001) stress that SCM involves the cooperation and coordination of activities of all partners for the production and distribution of products to the final consumer using a system to optimize inventories across the entire supply chain. Inventories are considered important to build up reserve seasonal demands or promotional sales (Shapiro, 2001).

### 2.5.4 Cross - functional teams

Cross-functional team involves two or more functions working together simultaneously on order fulfilment activities. The organisational practices that encourage team work, cross-functional communication and cooperation or collaboration organisational culture (Davenport & Prusak, 1998; Smith & Farquhar, 2000) is required in order to have an effective plan for order fulfilment in an organisation. Furthermore, Mollenkopf, et al. (2007) stress that cross-functional integration helps to handle external factors affecting the returns management process. Additionally, if an organisation has an integrated cross-functional team, it can solve more easily order fulfilment problems. Chen (2007, p. 687) state that the level of "investment and training on information technology is positively related to cross-functional team interaction; that when organisational structure is more decentralized and less formalized, cross-functional team interaction is more favourable; and that cross-functional team interaction is positively related to the performance."

A study conducted by Alexander, Lichtenstein, Jinnett, Wells, Zazzali, and Liu (2005) on cross-functional team processes in relation to improved patient outcomes revealed that patients treated in teams with higher levels of staff observed more improvement in activities of daily living. The results indicated that team process has important implications for patient outcomes. Therefore, we can conclude that cross-functional teams can have impact on order fulfilment to meet customers (e.g., patients) requirements. Sethi, Smith, and Park (2001) reported that innovativeness is positively

related to the strength of the team. In addition, they found that social cohesion between team members can result in a negative effect on innovativeness because of groupthink (Sethi et al., 2001).

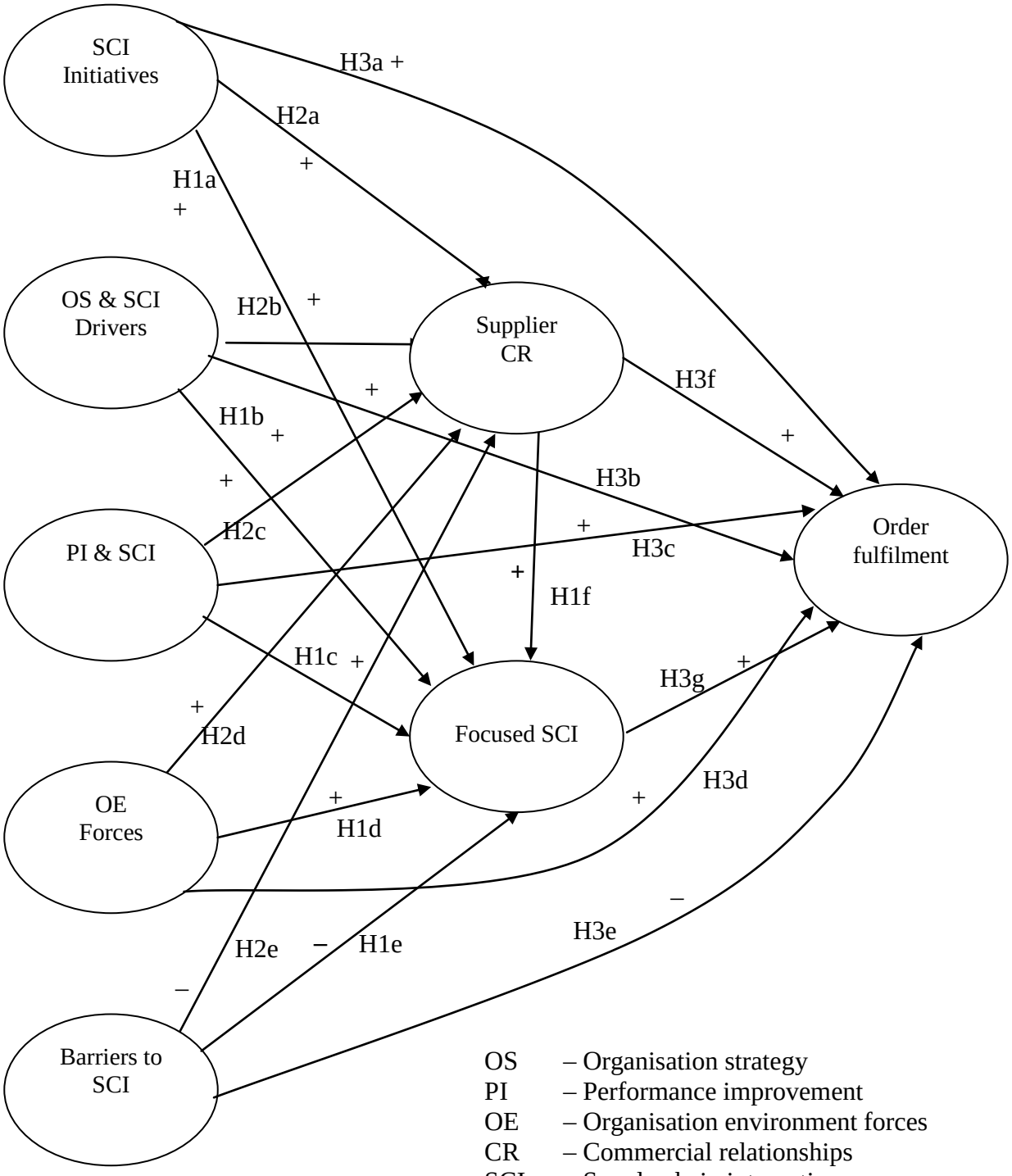
The literature indicates that there are different dimensions of measuring order fulfilment. This study will determine the critical factors that enhance order fulfilment in the public hospitals. The assumption is that SCI operational issues have impact on commercial supplier relationships, focused SCI, and order fulfilment. Therefore, order fulfilment is dependent on improved SCI operational issues, commercial supplier relationships, and focused SCI.

## 3. Conceptual model and hypotheses

### 3.1 Conceptual model

The primary objective of the current research is to develop an empirical understanding of the critical operational factors influencing the supply chain integration and their impact on supplier commercial relationships and order fulfilment in the NZ public hospital sector. It deals primarily with the following constructs indicated in the research model (Figure 3.0): supply chain integration initiatives, organisation strategy and SCI drivers, performance improvement and SCI, organisation environmental forces, barriers to SCI, supplier commercial relationships, focused SCI (all these are independent variables) and order fulfilment (dependent variable).

**Figure 3.0: Research model and hypotheses**



## 3.2 Hypotheses

A literature review on SCI, commercial supplier relationships and order fulfilment produced a conceptual model and eighteen hypotheses (Figure 3.0). The hypothesized integration relationships were developed in line with the research objectives and research questions indicated in section 1.0. The hypotheses are linked to the research questions for this study. They are exploratory and have not been empirically supported or tested.

In section 2.2, Operational issues were defined as the integration of operational activities and related matters in the organisation. In this section we initially identify the critical operational issues relating to supply chain integration. It is important to determine critical operational factors (issues) that affect the SCI in an organisation. Hoek and Weken (1998, p. 35) state that "the expected benefits of the increased integration in the inbound and outbound flow of goods are improved responsiveness to customers and increased efficiency." Furthermore, they questioned the extent organisations can increase the level of control over 'operational activities based on networking' (Hoek & Weken, 1998). Customer satisfaction depends on the level of performance improvement through the supply chain integration or linking of the organisational (operational) activities.

The importance of information technology (IT) on operational performance has been emphasized in a study by McAfee (2002), and found that there is a relationship between IT adoption and improvement in operational performance measures (McAfee, 2002). The need to integrate the operations from suppliers to customers has increased tremendously in order to support global operations. Effective enterprise integration includes systems and data, people, technology and business processes (Venkatachalam, 2006). The effect of interaction between corporate competitive capability and SC operational capability on performance improvement becomes insignificant as the developmental stage of SCI increases (Kim, 2006a, 2006b). Little is known in the literature concerning the influence of critical operational issues on SCI management processes, such as supplier commercial relationships, focused SCI, and order fulfilment. As a result of the

arguments mentioned above, there are operational issues affecting supply chain integration (SCI).

The nature of critical operational issues can have influence on order fulfilment. Thirumalai and Sinha (2005) revealed in their study of customer satisfaction with order fulfilment in retail supply chains that customers tend to have higher satisfaction levels with order fulfilment. However, the study conducted by Forslund (2006, p. 580) on performance gaps in the dyadic order fulfilment found that "customers' expectations are not perceived by customers as being fulfilled, customers' expectations are over-targeted by suppliers, but suppliers' internal performance decreases performance". Chen and Huang (2006) argue that competitive market pressures and globalization have forced the supply-chain system to reduce the operation time for every member to fast respond to the customers' requirements.

It not easy to meet the customers' needs within the estimated operation times due to uncertainties in a supply-chain (Chen & Huang, 2006). Reliability concerning order due date fulfilment is critical in customer service and customer retention, and it can be badly "influenced by supply chain uncertainties which may induce tardiness in various stages throughout the supply chain" (Chan, Chung, & Choy, 2006, p. 307).

The study on information sharing and coordination in make to order supply chains conducted by Sahin and Robinson (2005) found that 47.58% cost reduction was achieved as a result of changing from a traditional supply chain to a fully integrated system. In addition, they revealed that although information sharing reduces costs, the major benefit comes from coordinated decision making (Sahin & Robinson, 2005). In addition, "batching of orders yield the greatest savings particularly when smaller order sizes are common" (Petersen & Aase, 2004, p.11). However, many researchers, including Fry (1990); Bozart and Chapman (1996); Daugherty and Pitman (1995) emphasize that organisations should make their operations more flexible and responsive to their customers' requirements and order fulfillment. Furthermore, Shapiro, Rangan, and Sviokla (1992) stress that it is advantageous to consider the full order management cycle

for competitive advantages. It is important to examine the order fulfilment process in an organisation.

The following key hypotheses (H1a – H1e) for this research are considered:

**H1a: Supply chain integration initiatives have positive influence on focused supply chain integration**.

**H1b: Organisation strategy and supply chain integration drivers have positive influence on focused supply chain integration**.

**H1c: Performance improvement and supply chain integration have positive influence on focused supply chain integration**.

**H1d: Organisation environment forces have positive influence on focused supply chain integration**.

**H1e: Barriers to supply chain integration have negative influence on focused supply chain integration**.

Active organisations are responsive to customer expectations (Goldman, Nagel & Preiss, 1995; Zhang & Sharifi, 2000; Van Hoek, Harrison & Christopher, 2001). Monzcka, Petersen, Handfield, and Ragatz (1998) argue that organisations build strong relationships with suppliers who can meet their requirements and share similar performance objectives. In addition, Sislian and Satir (2000) emphasize the need for the flexibility of the supplier when making a buying decision.

Furthermore, Croxton (2003, p.19) state that "the order fulfilment process involves more than just filling order. It is about designing a network and a process that permits a firm to meet customer requests while minimizing the total delivered cost." However, a study by Lin and Huang (2002, p. 258) found that "the more detailed information shared between firms the lower the total cost, the higher the order fulfilment rate, and the shorter the order cycle time." They emphasized that information sharing can decrease the demand uncertainty faced

by the organisations (Lin & Huang, 2002). In addition, Pint and Baldwin (1997) argue that regular sharing of cost and technical information and wide-ranging face-to-face communication between buyer and supplier can result in improved understanding of the supplier regarding the buyers' requirements. Spitzeberg (2000) stresses that an effective communication can produce the desired results and enhance relationship.

Accordingly, it hypothesized that:

**H1f: Supplier commercial relationships have positive influence on focused supply chain integration**.

Many researchers have studied how the buying organisation handles its relationship with suppliers (i.e., buyer-supplier relationship). Recently, studies have also included supplier-supplier relationships, which have strategic implications for the buyer. They argue that every type of relationships is unique (Wu & Choi, 2005). Supplier relationships that engage higher value inputs and operations have higher risk levels because supplier failure can reduce the performance of the organisation (Walker, 1998).

A study conducted by Szwejczewski, Lemke, and Goffin (2005, p.875) revealed that relationships between firms and suppliers had "become closer and the use of partnerships was in evidence." In addition, Burt (1989, p.127) emphasize that "firms should engage in careful research and mutually beneficial relations with suppliers. When capacity permits, firms are better off with a single-source supplier." The results of the study on buyer-supplier relationships within a service sector conducted by Doran, Thomas, and Caldwell (2005) support the findings of Burt (1989). They found that "there are significant gaps between buyer and supplier expectations concerning how relationships should evolve and that the issues of power and trust will need to be explored in greater depth if relationships are to be optimized" (Doran et al., 2005, p. 272). The results of the study by Cannon and Homburg (2001) show that customer organisations intend to increase purchases from suppliers that offer value by decreasing costs.

Burns and New (1997, p.10) argue that "the effectiveness of integration at the operating level does not of itself remove other areas of potential conflict, particularly in the area of costs and pricing" when dealing with a supplier. They emphasize that conflicts can be solved with right managerial attention (Burns & New, 1997). In addition, Prahinski and Benton (2004, p. 39) state that "when a buying firm utilizes collaborative communication, the supplier perceives a positive influence on the buyer-supplier relationship." The study conducted by Sheu, Yen, and Chae (2006, p. 24) reveal that the "intensity" of collaboration rather than duration of the relationship can influence the retailer–supplier relationship. Furthermore, a study conducted by Johnston, McCutcheon, Stuart, and Kenwood (2004, p. 231) revealed that "shared planning and flexibility in coordinating activities" were strongly associated with the supplier trust in the buyer organisation. Thus, the following key hypotheses are considered:

**H2a: Supply chain integration initiatives have positive influence on supplier commercial relationships**.

**H2b: Organisation strategy and supply chain integration drivers have positive influence on supplier commercial relationships**

**H2c: Performance improvement and supply chain integration have positive influence on supplier commercial relationships.**

**H2d: Organisation environment forces have positive influence on supplier commercial relationships**.

**H2e: Barriers to supply chain integration have negative influence on supplier commercial relationships.**

In addition to the information highlighted for H1a - H1e and H2a – H2e, critical operational issues can have influence on focused SCI. Hui (2004) argue that "robust" supply chains integration needs to take into account a firm's resource capabilities and external environments. Hahn, Duplaga, and Hartley (2000) state that improved customer satisfaction can be achieved through good integration of

functional activities. "In order to improve efficiency and effectiveness in managing business processes that produce and deliver goods and services requires the integration of operations management and information systems both within the organization and with the supply chain partners" (Barnes, Hinton, & Mieczkowska, 2003, p. 659). The results of a study by Rosenzweig, Roth, and Dean (2003, p. 437) indicate that "supply chain integration intensity leads directly to improved business performance." The study on achieving world-class supply chain alignment conducted by Fawcett and Magnan (2001) highlights the following operational issues which are adopted in the current study: SCI initiatives, organisation strategy and SCI drivers, performance improvement and SCI, organisation environment forces, and barriers to SCI. This leads to the following hypotheses (H3a – H3f):

**H3a: Supply chain integration initiatives have positive influence on order fulfilment**.

**H3b: Organisation strategy and supply chain integration drivers have positive influence on order fulfilment.**

**H3c: Performance improvement and supply chain integration have positive influence on order fulfilment**.

**H3d: Organisation environment forces have positive influence on order fulfilment**.

**H3e: Barriers to supply chain integration have negative influence on order fulfilment.**

**H3f: Supplier commercial relationships have positive influence on order fulfilment.**

Further to the information provided for H3a – H3f, order fulfilment can have influence on focused supply chain integration. Chen, Drezner, Ryan, and Simchi-Levi (2000) and Lee, So, and Tang (2000) emphasize the use of periodic review systems when the demand is auto correlated. Sharing point-of-sale demand

information assists the manufacturer to improve his forecast and reduce total inventory costs. They also argue that centralizing customer demand information does not completely eliminate the bullwhip effect (distortion of demand information). The study on information sharing and coordination in make-to-order supply chains conducted by Sahin and Robinson (2005, p. 579) reveals that there is a "cost reduction moving from a traditional supply chain to a fully integrated system."

As a result of the arguments highlighted above, order fulfilment should have a positive influence on focused supply chain integration:

**H3g: Focused supply chain integration has a positive influence on order fulfilment.**

The hypotheses are indicated in Tables 1.0a and 1.0b.

**Table 1.0a: Research model hypotheses**

**H1a:** Supply chain integration initiatives have positive influence on focused supply chain integration.

**H1b:** Organisation strategy and supply chain integration drivers have positive influence on focused supply chain integration.

**H1c:** Performance improvement and supply chain integration have positive influence on focused supply chain integration.

**H1d:** Organisation environment forces have positive influence on focused supply chain integration.

**H1e:** Barriers to supply chain integration have negative influence on focused supply chain integration.

**H1f:** Supplier commercial relationships have positive influence on focused supply chain integration.

**H2a:** Supply chain integration initiatives have positive influence on supplier commercial relationships.

**H2b:** Organisation strategy and supply chain integration drivers have positive influence on supplier commercial relationships

**H2c:** Performance improvement and Supply chain integration have positive influence on supplier commercial relationships.

**Table 1.0b: Research model hypotheses (cont.)**

**H2d:** Organisation environment forces have positive influence on supplier commercial relationships.

**H2e:** Barriers to supply chain integration have negative influence on supplier commercial relationships.

**H3a:** Supply chain integration initiatives have positive influence on order fulfilment.

**H3b:** Organisation strategy and supply chain integration drivers have positive influence on order fulfilment.

**H3c:** Performance improvement and Supply chain integration have positive influence on order fulfilment.

**H3d:** Organisation environment forces have positive influence on order fulfilment.

**H3e:** Barriers to supply chain integration have negative influence on order fulfilment.

**H3f:** Supplier commercial relationships have positive influence on order fulfilment.

**H3g:** Focused supply chain integration has a positive influence on order fulfilment.

## 4.0 Survey methodology research

Survey methodology is used in this study. A survey involves the collection of information from individuals (through mailed questionnaire, personal interviews, etc.) about themselves or concerning the social units to which they belong (Rossi, Wright, & Anderson, 1983). Surveys are useful to test hypotheses and to generalise findings.

Data collection based on the procedures suggested by Fowler (2002); Alreck and Settle (2004), such as information needs, sampling design, instrumentation, data collection, data processing, and report generation. In addition, Marston and Straker (2001) procedures were used for both personal interviews and mail surveys. Surveys are the widely used data collection methods for organisational research (Zikmund, 2000). Forza (2002) also stresses that survey research is important and widely used in operations management.

### 4.1 Sample

This study applies survey methodology for data collection. The sampling frame for the survey is composed of the 40 public hospitals and 21 DHBs with purchasing and supply personnel directly involved in purchasing goods and services for the public hospitals. A list of purchasing and supply managers was obtained from the New Zealand District Health Boards (NZDHBs) with contact email addresses. Postal addresses were obtained from the Ministry of Health website which provides the DHBs' and public hospitals' addresses. The sample size for the pilot study was 150 and the main study was 350 composed of purchasing and supply personnel.

The pilot study was divided into two parts. First, interviews with the purchasing and supply executives and used the result to improve the questionnaire. In addition, purchasing and supply executives, and academics commented on the clarity of the instructions and validity of the questionnaire. Eighty nine items were developed to measure eight constructs of the conceptual model (Figure 3.0) for the pilot study. Secondly, the survey was sent to 150 purchasing and supply personnel in the DHBs and public hospitals. A reminder e-mail was sent to the potential respondents (procurement managers and chief finance officers dealing with procurement), after

two weeks. To my surprise only six usable responses were returned. Two additional reminder e-mails were sent out to the potential respondents, and resulted in nine extra responses. The sample was too small for rigorous statistical testing, but the responses were enough to determine good items for the main survey. The T- test indicated that there was no significant non-response bias in the data received from the pilot study.

The main study was conducted using a revised survey questionnaire which was sent to 350 purchasing and supply personnel in 21 DHBs and 40 public hospitals. The main contact was through the managers in charge of purchasing and supply in each DHB selected from the NZDHBs list and then the managers distributed the survey questionnaires to their subordinates. Communicating with the purchasing and supply managers of the DHBs helped to reduce mailing costs. In addition, other questionnaires were sent to the 40 public hospitals listed on the Ministry of Health website. The survey followed Dillman's (1978, 2000) guidelines on mail survey. The mailing package included the respondent's information sheet, the survey questionnaire, and a paid return envelop.

Of the 350 survey questionnaires sent to the potential respondents, 8 questionnaires were returned due to change of address and the contact person was no longer at the hospital. A total of 41 usable responses were received representing 11.71% response rate.

A reminder e-mail (Dillman, 2000) was sent to the purchasing and supply managers, and the chief finance officers (who control 50% of procurement budget) after two weeks from the first mailing, so that they can remind their subordinates (non-respondents) to respond to the survey questionnaire. The reminder e-mail (with a questionnaire attached) emphasised the importance of their response to the achievement of the research objectives. One week later, the potential respondents were contacted by phone to remind them on the importance of the study and requested them to complete the survey questionnaire if they had not yet completed it. A total of 10 extra responses were received which increased the total responses to 51 (response rate of 14.6%). Further reminder e-mail sent to the purchasing and supply personnel achieved extra nine usable responses. Finally, a total of 60 usable responses were received representing 17.14% response rate.

The results of the Levene's test evaluate the assumption, whether the population variance of the two groups are equal. The result shows that the variances are relatively equal, $p > 0.05$. Therefore, there is no significant non-response bias in the data received from the main study.

## 4.2 Development of survey questionnaire

In order to effectively design and validate the survey questionnaire, a comprehensive review of the literature was conducted to identify scales that have been used in past studies to measure the constructs discussed in the research model. In addition, interviews with senior purchasing and supply executives were carried out, and provided additional scale items related to the operations of the public hospitals. However, SCI operational issues (factors) were adopted from Fawcett and Magnan (2001) because they were similar to the responses from the interviews. The scales were validated using Churchill's paradigm (Churchill, 1979) to ensure that a valid and reliable scale was developed for the purpose of this study. The initial survey questionnaire was reviewed by the academics and practitioners in purchasing and supply area for content, clarity and easy understanding. The review was conducted by three academics, two supervisors and one academic from another institution. In addition, the review of the survey was carried out by two senior purchasing and supply executives in the public hospitals.

The survey questionnaire was revised after considering the comments from the reviewers, academics and purchasing and supply executives. Useful comments were obtained from the purchasing and supply executives during the interviews, and one respondent completed the questionnaire. The analysis was done using cross-case analysis (Yin, 2003) for the interviews. The initial survey questionnaire before the review process contained items generated from the literature review. The purchasing and supply executives reviewed the survey questionnaire which was already refined and ready for completion by the practitioners, for testing purposes.

The modified survey questionnaire had multiple items, which were used to determine whether there was internal consistence, discriminant, and convergent validity.

### 4.2.1 Scale Development

In order to gather reliable data, it was important to design a valid and reliable survey questionnaire for this research and future studies. Initially, an extensive review of the literature was conducted to identify scales that have been used in previous studies, and they are valid and reliable. The items used in the previous research related to the constructs of this study were determined, especially the measurement items concerning the SCI operational issues most were adapted from the past study on achieving world-class supply chain alignment conducted by Fawcett and Magnan (2001) of the Arizona Advanced Center for Purchasing Studies. Other items originated from the interviews. The pool of items identified in the literature and interviews for each construct were evaluated by academics and purchasing and supply personnel to make sure that questionnaire items were suitable for this study on public hospitals.

SCI operational issues are composed of the following constructs: (1) supply chain integration (SCI) initiatives; (2) organisation strategy and SCI drivers; (3) performance improvement and SCI; (4) organisation environmental forces; and (5) barriers to SCI.

The construct supplier commercial relationship was defined in section 2.3. The items that have been developed for this study are from the interviews and past general literature on supplier relationships. The initial search for the measurements identified forty six different common items from the literature, some of which overlap in meanings. Therefore, after removing duplicate items, the remaining measurements were selected for this study. In addition, some of the items from the interviews were similar to those from the literature.

Focused supply chain integration is composed of behavioural factors for this study (see section 2.4). The items that have been developed for this study are from the interviews with purchasing and supply executives

The construct order fulfilment (section 2.5) items that have been developed for this study are from the interviews and past general literature on order fulfilment. The

initial search for the measurements identified twenty five different common items from the literature, some of which overlap in meanings. Therefore, after removing duplicate items, the remaining measurements were selected for this study. In addition, some of the items from the interviews were similar to those from the literature.

The final survey questionnaire is in Appendix A. Factor analysis (extraction method: principal component analysis with varimax rotation) was used to determine the final measurement items for each construct (see Table 5.0).

Table 2.0 indicates the correlation matrix, means and standard deviations for the final measures.

## 5.0 Analysis

### 5.1 Assessment of the normality

The data were assessed to determine normality of distribution because factor analysis and multiple regression analysis both need variables to be normally distributed.

Table 2.0: Correlation matrix of construct measures

Pearson Correlation Coefficients and significance levels

| | Item | | Mean, S.D | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SI1 | Cross Functional Process | (3.567, 0.851) | 1 | | | | | | | | |
| 2 | SI2 | Integration with customers | (3.733, 0.709) | .675** | 1 | | | | | | | |
| 3 | ST1 | Corporate Strategy Includes SC1 | (3.567, 1.014) | .584** | .496** | 1 | | | | | | |
| 4 | ST2 | Centralised Purchasing | (3.783, 1.106) | .421** | .292** | .413** | 1 | | | | | |
| 5 | SP1 | Handle Expected Challenges | (3.567, 0.789) | .700** | .668** | .799** | .473** | 1 | | | | |
| 6 | SP2 | Lowering cost of items | (3.967, 0.712) | .535** | .552** | .566** | .485** | .667** | 1 | | | |
| 7 | SP3 | Profitability | (3.3, 0.849) | .159 | .219 | .389** | .341** | .450** | .493** | 1 | | |
| 8 | SE1 | Suppliers initiated integration | (3.067, 0.954) | -.006 | .002 | .258* | -.195 | .084 | -.121 | .309* | 1 | |
| 9 | SE2 | Customers initiated integration | (3.283, 0.993) | -.093 | .013 | .259* | -175 | .008 | .0.38 | .259* | .552** | 1 |

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Table 2.0: Correlation matrix of construct measures (Cont.)

| Item | | | Mean, S.D | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | SB1 | Lack to share information | (3.25, 0.856) | 1 | | | | | | | | | |
| 11 | SB2 | Difficult to establish relationship | (3.3, 0.889) | .724** | 1 | | | | | | | | |
| 12 | SB4 | Inappropriate Information | (3.867, 0.747) | .132 | .163 | 1 | | | | | | | |
| 13 | SC 1 | Reliable suppliers | (3.867, 0.596) | .000 | -.243 | -.307* | 1 | | | | | | |
| 14 | SC 3 | Good process integration | (3.417, 0.889) | -.273* | -.182 | -.094 | .555** | 1 | | | | | |
| 15 | FC 1 | Functions are integrated | (3.133, 0.911) | -.326* | -.239 | -.123 | .377** | .475** | 1 | | | | |
| 16 | FC 2 | Rational policies and procedures | (3.883, 0.958) | -.232 | -.356** | -.211 | .240 | .177 | .445** | 1 | | | |
| 17 | OF 1 | Classify inventories | (3.7, 0.849) | .082 | -.350** | -.037 | .288* | .168 | .272* | .227 | 1 | | |
| 18 | OF 2 | Collaborative planning | (3.333, 1.036) | .096 | .037 | -.139 | .430** | .399** | .365** | .006 | .308 | 1 | |
| 19 | OF 3 | Effort to Control Costs | (3.667, 0.933) | .403** | .225 | -.308* | .193 | -.116 | .253 | .145 | .278* | .292* | 1 |

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

The distribution of variables to be used in the analysis was checked for normality (Hair et al., 2006; Tabachnick & Fidell, 2001; Kline, 2005). A visual examination of the normal probability plots of the residuals (errors in predicting sample data), indicated a normal distribution of the values, and meet the assumption of normality.

In order to assess the distribution of the variables, it was necessary to check for outliers. Outliers are defined as "observations with a unique combination of characteristics identifiable as distinctly different from the other observations" (Hair et al., 2006, p.64). The outliers were checked using the partial regression plots which helped to identify influential observations for each independent-dependent observations relationship (Hair et al., 2006). All the variables were well represented by the relationship and they could not affect the partial correlation. The outliers can result in non-normality data and falsify statistical tests (Hair et al., 2006; Tabachnick & Fidell, 2001).

The actual deviation from the normality of distribution was determined using skewness and kurtosis. Skewness refers to the "measure of symmetry of a distribution; in most instances the comparison is made to a normal distribution", and Kurtosis refers to the "measure of the peakedness or flatness of distribution when compared with a normal distribution" (Hair et al., 2006, p.37). A variable with an absolute value of Kurtosis index greater than 10.0 indicates there is a problem with normality and values greater than 20.0 indicate a more serious normality problem (Kline, 2005). Therefore, the acceptable absolute value of skewness and kurtosis should not exceed three and ten respectively. The SPSS version 17 used to check both skewness and kurtosis showed that the absolute values were within the acceptable levels (see Table 3.0), that is there is univariate normality. The final descriptive statistics for the items used in this study are also indicated in Table 3.0.

Table 3.0: Measures of the constructs and descriptive statistics

| Construct/ Items | Mean | Std.Deviation | Skewness | Kurtosis |
|---|---|---|---|---|
| **Supply chain integration Initiatives (SI)** | | | | |
| • Cross-functional process integration within the hospital (SI1) | 3.567 | 0.851 | - 0.557 | - 0.375 |
| • Integration with customers (SI2) | 3.733 | 0.709 | - 0.739 | 0.752 |
| • Integration with first-tier suppliers (SI3) | 3.633 | 0.863 | - 0.347 | - 0.424 |
| • Complete customers and suppliers supply chain integration (SI4) | 3.133 | 0.891 | 0.027 | 0.233 |
| **Organisation strategy and SC1 drivers (ST)** | | | | |
| • Our organisation's corporate strategy includes SC1 (ST1) | 3.567 | 1.015 | - 0.842 | 0.427 |
| • We have a centralised purchasing department (ST2) | 3.783 | 1.106 | - 0.796 | - 0.134 |
| • Our organisation promotes integration through use of information technology (ST3) | 3.617 | 0.885 | - 0.975 | 1.310 |
| • Lowering costs is a core driver of our SC1 (ST4) | 4.233 | 0.745 | - 0.411 | - 1.076 |
| • Improving services level is another core driver influencing our SC1 in our hospital (ST5) | 4.267 | 0.634 | - 0.283 | - 0.611 |
| **Performance improvement and SC1 (SP)** | | | | |
| • Ability to handle expected challenges (SP1) | 3.567 | 0.789 | - 0.334 | - 0.241 |
| • Lowering cost of purchased items (SP2) | 3.967 | 0.712 | - 0.534 | 0.656 |
| • Hospital profitability (SP3) | 3.300 | 0.849 | 0.058 | - 0.637 |
| • Inventory costs (SP4) | 3.433 | 0.889 | 0.059 | - 0.673 |
| • On-time delivery/due-date performance (SP5) | 3.967 | 0.519 | - 0.051 | 0.917 |
| • Order fulfilment lead times (SP6) | 3.917 | 0.591 | 0.015 | - 0.045 |
| • Overall customer satisfaction (SP7) | 3.650 | 0.633 | 0.028 | - 0.206 |

Table 3.0 (cont.)

| Construct/Items | Mean | Std.Deviation | Skewness | Kurtosis |
|---|---|---|---|---|
| • Responsiveness to customer requests (SP8) | 3.617 | 0.715 | 0.723 | - 0.705 |
| • Total productivity (SP9) | 3.583 | 0.619 | 0.560 | - 0.561 |
| **Organisation environmental forces (SE)** | | | | |
| • Suppliers have initiated integration effort (SE1) | 3.067 | 0.954 | 0.590 | - 0.517 |
| • Customers have initiated integration efforts (SE2) | 3.283 | 0.993 | - 0.068 | - 1.250 |
| • Desire to lower supply chain costs (SE3) | 4.200 | 0.605 | - 0.589 | 1.975 |
| • Desire to focus on core competence in services (SE4) | 3.917 | 0.849 | - 0.352 | - 0.525 |
| **Barriers to SC1 (SB)** | | | | |
| • A lack of willingness to share information (SB1) | 3.250 | 0.856 | - 0.346 | - 1.241 |
| • Difficult to establish relationships based on shared risks and rewards (SB2) | 3.300 | 0.889 | - 0.489 | - 1.299 |
| • Difficult to evaluate contribution of each supply chain member (SB3) | 2.967 | 0.712 | 0.048 | - 0.977 |
| • Inappropriate information systems (SB4) | 3.867 | 0.747 | - 0.281 | - 0.093 |
| • Inconsistent operating goals (SB5) | 3.017 | 0.873 | 0.599 | - 0.208 |
| • Budget limitation for supply chain resources (SB6) | 3.483 | 0.911 | - 0.436 | - 0.779 |
| • Lack of suppliers to comply with agreed key performance indicators (SB7) | 3.050 | 1.141 | 0.182 | - 1.027 |
| • Government procurement policies and procedures (SB8) | 3.100 | 0.915 | - 0.066 | 0.379 |
| • Organisational boundaries prevent integration (SB9) | 3.433 | 0.909 | - 0.006 | - 0.755 |
| **Supplier commercial relationships (SC)** | | | | |
| • We have reliable suppliers (SC1) | 3.867 | 0.596 | - 0.953 | 2.449 |
| • We promote partnership with dedicated suppliers (SC2) | 3.950 | 0.832 | - 1.000 | 0.983 |

Table 3.0 (cont.)

| Construct/ Items | Mean | Std.Deviation | Skewness | Kurtosis |
|---|---|---|---|---|
| • We have good process integration between suppliers, customers and the DHB (SC3) | 3.417 | 0.889 | - 0.339 | - 0.833 |
| • We have joint or collaborative planning (SC4) | 3.383 | 1.059 | - 0.568 | - 0.439 |
| • We make effective negotiations with suppliers (SC5) | 3.850 | 0.606 | - 1.345 | 3.225 |
| **Supplier commercial relationships (SC) cont.** | | | | |
| • We use KPIs in judging our suppliers (SC6) | 3.317 | 0.854 | - 1.008 | 0.087 |
| • We have a service level agreement (SC7) | 3.700 | 0.591 | - 0.836 | 0.933 |
| • We use a contract to maintain relationship (SC8) | 4.033 | 0.736 | - 2.166 | 8.521 |
| • We have single source relationships (SC9) | 2.950 | 0.769 | 0.086 | 1.301 |
| **Focused supply chain integration (FC)** | | | | |
| • Our service functions are integration (FC1) | 3.133 | 0.911 | - 0.133 | 0.437 |
| • We follow national procure-ment policies and procedures (FC2) | 3.883 | 0.958 | - 0.597 | - 0.476 |
| • We use enterprise resource planning (ERP) system (FC3) | 3.033 | 1.008 | - 0.377 | - 0.931 |
| • We use an online purchasing system (FC4) | 3.333 | 1.052 | - 0.716 | 0.072 |
| • Top management is committed to supply chain integration (FC5) | 3.583 | 1.029 | - 0.520 | - 0.158 |
| • We have good organisational culture that supports supply chain integration (FC6) | 3.083 | 1.013 | 0.132 | - 0.670 |
| • Our organisation structure is good for internal supply chain integration (FC7) | 3.467 | 0.892 | - 0.341 | 0.684 |

Table 3.0 (cont.)

| Construct/ Items | Mean | Std.Deviation | Skewness | Kurtosis |
|---|---|---|---|---|
| **Order fulfilment (OF)** | | | | |
| • We classify inventories according to their importance (OF1) | 3.700 | 0.849 | - 0.916 | 0.227 |
| • We have collaborative planning, forecasting and replenishment (CPFR) (OF2) | 3.333 | 1.036 | - 0.151 | - 0.557 |
| • We make an effort to control ordering costs (OF3) | 3.667 | 0.933 | - 0.571 | - 0.487 |
| • Suppliers have capacity to meet the demand (OF4) | 3.867 | 0.700 | - 0.423 | 0.468 |
| • We have the capacity to respond to demand fluctuations (OF5) | 3.833 | 0.763 | - 2.076 | 5.884 |
| **Order fulfilment (OF)_cont.** | | | | |
| • Suppliers (vendors) manage our inventory (OF6) | 2.517 | 0.813 | 0.140 | - 0.434 |
| • We do maintain high levels of emergency supplies (OF7) | 3.533 | 0.982 | - 0.817 | - 0.373 |
| • We emphasize to suppliers that accuracy and efficiency of order fulfilment is important (OF8) | 4.150 | 0.819 | - 1.052 | 2.136 |

**Note:** Calculations are based on 60 measurement items and used 5-point Likert scale.

In addition, the visual assessment of normal probability plots indicated that there was no serious deviation from normality. All the values clustered around the straight line. Therefore, there was no need to make any adjustments such as transformation of the data (Tabachnick and Fidell, 2001).

## 5.2 Profile of respondents

The data used for main study was collected from purchasing and supply personnel from 40 public hospitals and 21 District Health Boards (DHBs). The majority of informants didn't complete the general information section of the survey because of confidentiality. The respondents who indicated their positions/ titles are in Table 4.0.

Table 4.0: Respondents Profile

| Position | Frequency | % |
|---|---|---|
| • Corporate services manager (Procurement) | 2 | 3.3 |
| • Procurement/logistics manager | 10 | 16.7 |
| • Procurement specialist | 7 | 11.6 |
| • Procurement officer/administrator | 14 | 23.4 |
| • Chief finance officer/manager (Procurement) | 4 | 6.7 |
| • Title not reported | 23 | 38.3 |
| Total | 60 | 100.0 |

## 5.3 Reliability analysis

After unidimensionality is determined, reliabilities can be estimated for each construct. The scale reliability feature of SPSS version 17 was used to determine reliabilities for each construct using Cronbach's alpha. Table 4.0 shows the reliabilities of final constructs. The newly developed constructs have reliabilities between 0.551 (close to 0.6) and 0.679 which meet a minimum value of alpha (0.6) recommended, and the adapted constructs had reliabilities between 0.625 (close to 0.7) and 0.798 which are acceptable. The barriers to supply chain integration construct has the lowest reliability of 0.625 and not removed because it has alpha value close to 0.7 acceptable reliability for old construct. There was no improvement of reliability after removing a measurement item with low loading from each construct.

## 5.4 Construct Validity

After reliability analysis, the next stage is the evaluation of construct validity (Churchill, 1979). Construct validity is directly related to what the instrument is measuring (Churchill, 1979). Construct validity refers to the degree to which a set of measured variables actually represent the theoretical construct they are designed to measure (Hair et al., 2006). In order to ensure construct validity measures must have convergent validity and discriminated validity. For convergent validity the items of specific construct should converge or share a high proportion of variance in its common, and discriminant validity is the extent to which a construct validity is different from other constructs. High dicriminant validity shows evidence that a construct is unique and captures some phenomena other measures do not (Hair et al., 2006).

Factor analysis provides support for acceptable convergent validity. Table 5.0 shows high factor loadings on a factor that indicate they converge on some common point. A good rule of thumb is that standardized loadings estimates should be 0.5 or higher, and ideally 0.7 or higher (Hair et al., 2007). The factor loadings for the final constructs range from 0.767 to 0.936. Also, the values of item communalities are high supporting convergent validity.

Furthermore, the correlation matrix (Table 2.0) of constructs was analysed to check convergent validity and discriminant validity. Composite scores were determined for each construct by averaging the raw scores of measurement items that constitute the construct.

Table 5.0: Factor loading and reliability

| Construct | Measurement item | Loading | Alpha |
|---|---|---|---|
| Supply chain integration initiatives (SI) | SI1 | 0.780 | |
| | SI2 | 0.924 | 0.798 |
| Organisation strategy and SC1 drivers (ST) | ST1 | 0.767 | |
| | ST2 | 0.921 | 0.583 (close to 0.6 acceptable) |
| Performance improvement and SC1 (SP) | SP1 | 0.899 | |
| | SP2 | 0.846 | 0.769 |
| | SP3 | 0.883 | |
| Organisation environmental forces (SE) | SE1 | 0.912 | |
| | SE2 | 0.875 | 0.711 |
| Barriers to SC1 (SB) | SB1 | 0.936 | |
| | SB2 | 0.878 | 0.625 |
| | SB4 | 0.802 | |
| Supplier commercial relationships (SC) | SC1 | 0.869 | |
| | SC3 | 0.792 | 0.679 |
| Focused supply chain integration (FC) | FC1 | 0.844 | |
| | FC2 | 0.842 | 0.616 |
| Order fulfilment (OF) | OF1 | 0.794 | |
| | OF2 | 0.813 | 0.551 (close to 0.6 acceptable) |
| | OF3 | 0.884 | |

The indicators or variables in each construct (Table 5.0) are highly inter-correlated and highly reliable, showing that all indicators are measuring the same (latent) construct (Hair et al., 2006).

Table 6.0: Evidence of convergent validity

| Construct | Measurement item | Pearson correlation | Significance (2-tailed) |
|---|---|---|---|
| Supply chain integration initiatives (SI) | SI1 | 0.931 | 0.01 |
| | SI2 | 0.898 | 0.01 |
| Organisation strategy and SC1 drivers (ST) | ST1 | 0.825 | 0.01 |
| | ST2 | 0.855 | 0.01 |
| Performance improvement and SC1 (SP) | SP1 | 0.845 | 0.01 |
| | SP2 | 0.850 | 0.01 |
| | SP3 | 0.798 | 0.01 |
| Organisation environmental forces (SE) | SE1 | 0.876 | 0.01 |
| | SE2 | 0.886 | 0.01 |
| Barriers to SC1 (SB) | SB1 | 0.846 | 0.01 |
| | SB2 | 0.863 | 0.01 |
| | SB4 | 0.532 | 0.01 |
| Supplier commercial relationships (SC) | SC1 | 0.827 | 0.01 |
| | SC3 | 0.926 | 0.01 |
| Focused supply chain integration (FC) | FC1 | 0.842 | 0.01 |
| | FC2 | 0.858 | 0.01 |
| Order fulfilment (OF) | OF1 | 0.696 | 0.01 |
| | OF2 | 0.765 | 0.01 |
| | OF3 | 0.717 | 0.01 |

The convergent validity of the scales was determined by checking the individual item correlations (Table 6.0). The measurement item correlations in each construct are between 0.696 and 0.931. There is evidence that the scales show strong convergent validity and they are adequate for measurement of the regression model.

## 5.5 Multiple regression analysis and test of hypotheses

The model in Figure 3.0 was tested using SPSS version 17 for multiple regression analysis and test hypotheses. Multivariate analysis (simultaneous analysis of more than two variables) is very important in operations management (Forza, 2002). Multiple regression analysis predicts the changes in the dependent variable in response to changes in the several independent variables (Forza, 2002). The multiple regression analysis was used to test the relationships between the constructs based on the hypothesised model (see figure 3.0).

Eighteen hypotheses were tested and only two hypotheses (H1d: organisation environmental forces have positive influence on focused supply chain integration; and H2d: organisation environmental forces have positive influence on supplier commercial relationship were not statistically significant and not supported. The hypotheses of this study are discussed in the following section 5.6. Tables 9.0 – 26.0 (see Appendix B) indicate all the regression results. Collinearity diagnostics of the SPSS version 17 were used to test for potential multicollinearity effects. Multicollinearity refers to "the correlation among three or more independent variables (evidenced when one is regressed against the others)" (Hair et al., 2006, p. 156). As multicollinearity rises, the ability to define any variables effect is diminished" (Hair et al., 2006, p. 186). Two measurements of multicollinearity were used in this study: tolerance and condition index. Tolerance is a direct measure of multicollinearity. It is the amount of variability of selected independent variable not explained by other independent variables (Hair et al., 2006). Tolerance of variable is I - R-squared ($I-R^2$) (the coefficient of determination for the prediction of variable by the other predictor variables). Condition index is a "measure of the relative amount of variance associated with an eigenvalue so that a large condition index indicates a high degree of collinearity" (Hair et al., 1998, p. 218). The regression analysis of all the hypotheses indicated tolerance (> 20) and condition indices (< 30) showing that there is no significant multicollinearity effects (Garson, 2008; Hair et al., 2006).

## 5.6 Results of testing the hypotheses

This study contains eighteen hypothesised relationships (see Tables 1.0a and 1.0b). Tables 9.0 – 26.0 for hypotheses testing results are in the Appendix B.The implications of the hypotheses testing results are further discussed in section 7.0.

### 5.6.1 Supply chain integration initiatives and focused supply chain integration

**Hypothesis H1a:** Supply chain integration initiatives have positive influence on focused supply chain integration.

According to the results presented in Table 9.0 this hypothesis was statistically significant at the $p = 0.01$ level ($R^2 = 0.422$, $F = 20.781$, $p = 0.000$), and the H1a was strongly supported. However, only the relationship between integrated service functions and integration with customers was significant ($\beta = 0.499$, $t = 3.653$, $p = 0.001$). The results are strong for service functions are integrated, with supply chain integration initiatives explaining 42.2% of the variance in the service functions are integrated scores.

In addition, the model results provide more insights. The cross-functional process within the hospital has no significant impact on any of the focused supply chain integration measures. Also, integration with customers, has no significant impact on following national procurement policies and procedures.

### 5.6.2 Organisation strategy and SCI drivers and focused supply chain integration

**Hypothesis H1b:** Organisation strategy and supply chain integration drivers have positive influence on focused supply chain integration.

This hypothesis is statistically significant at the $p = 0.01$ level (see Table 10.0) and strongly supported ($R^2 = 0.354$, $F = 15.617$, $p = 0.000$) for the relationship between organisation strategy and SCI drivers, and focused supply chain integration, with one

independent variable, organisation's corporate strategy includes SCI, having a significant positive impact on the model ($\beta = 0.428$, $t = 3.658$, $p = 0.001$). The result is strong for service functions are integrated, with organisation strategy and SCI drivers explaining 35.4% of the variance in the service functions are integrated scores.

This hypothesis is also statistically significant at $p = 0.01$ level and strongly supported ($R^2 = 0.199$, $F = 7.059$, $p = 0.002$) for the relationship between organisation strategy and SCI drivers, and following national procurement policies and procedures, with one independent variable, organisation's corporate strategy includes SCI, having a significant positive impact on the model ($\beta = 0.312$, $t = 2.393$, $p = 0.020$). The result is strong for follow national procurement policies and procedures with organisation strategy and SCI drivers explaining 19.9% of the variance in the follow national procurement policies and procedures scores. The organisation's corporate strategy that includes SCI has positive impact on both measurement items of focused supply chain integration.

Furthermore, the model results provide more insights. The centralised purchasing department has no significant impact on both service functions are integrated and following national procurement policies and procedures.

### 5.6.3 Performance improvement, SCI, and focused supply chain integration

**Hypothesis H1c:** Performance improvement and supply chain integration have positive influence on focused supply chain integration.

The results in Table 11.0 provide strong support for this hypothesis. The hypothesis is statistically significant at $p = 0.01$ level for the relationship between performance improvement and SCI, and service functions are integrated ($R^2 = 0.375$, $F = 11.193$, $p = 0.000$), with two independent variables, ability to handle expected challenges and lowering cost of purchased items, having a significant positive impact on the dependent variable service functions are integrated ($\beta = 0.420$, $t = 2.908$, $p = 0.005$; $\beta = 0.287$, $t = 1.935$, $p = 0.058$, respectively). The result is strong for service functions are integrated, with performance improvement and SCI explaining 37.5% of the variance in the service functions are integrated scores. The relationship between

performance improvement and SCI, and following national procurement policies and procedures is not significant ($R^2 = 0.106$, $F = 2.220$, $p = 0.096$).

Hospital profitability is the only independent variable to show non significant impact results on both dependent variables: service functions are integrated, and following national procurement policies and procedures. However, hospital profitability has a negative impact on service functions integrated and following national procurement policies and procedures, but not statistically significant.

The model results provide additional insights. The ability to handle expected challenges and lowering cost of purchased item have no significant impact on following national procurement policies and procedures.

### 5.6.4 Organisation environment forces and focused supply chain integration

**Hypothesis H1d:** Organisation environment forces have positive influence on focused supply chain integration.

The results in Table 12.0 do not provide support for this hypothesis. The hypothesis is not statistically significant for the relationship between organisation environmental forces and both service functions are integrated and following national procurement policies and procedures ($R^2 = 0.051$, $F = 1.533$, $p = 0.225$; $R^2 = 0.021$, $F = 0.597$, $p = 0.554$, respectively). The model results provide additional insights that are not statistically significant. The independent variable suppliers have initiated integration effort has negative impact on dependent variables: service functions are integrated and following national procurement policies and procedures ($\beta = -0.160$, $t = -1.033$, $p = 0.306$; $\beta = -0.020$, $t = -0.130$, $p = 0.897$, respectively). The customers have initiated integration effort measure shows no significant positive impact on both service functions are integrated and following national procurement policies and procedures ($\beta = 0.271$, $t = 1.749$, $p = 0.086$; $\beta = 0.153$, $t = 0.976$, $p = 0.333$, respectively).

### 5.6.5 Barriers to supply chain integration and focused supply chain integration

H1e: Barriers to supply chain integration have negative influence on focused supply chain integration.

The results in Table 13.0 provide support for this hypothesis. The hypothesis is statistically significant at p = 0.05 level for the relationship between barriers to supply chain integration and service functions are integrated ($R^2$ = 0.113, F = 2.373, p = 0.080), with one independent variable, lack of willingness to share information, having a negative impact on the dependent variable service functions are integrated (β = - 0.320, t = - 1.751, p = 0.085). The result is moderately strong for service functions are integrated, with barriers to supply chain integration explaining 11.3% of the variance in the service functions are integrated scores. The hypothesis is also statistically significant at p = 0.01 level for the relationship between barriers to supply chain integration and following national procurement policies and procedures ($R^2$ = 0.153, F = 3.363, p = 0.025), with one independent variable, difficult to establish relationships based on shared risks and rewards having a negative impact on the dependent variable following national procurement policies and procedures (β = - 0.373, t = - 2.079, p = 0.042). The result is moderately strong for following national procurement policies and procedures, with barriers to supply chain integration explaining 15.3% of the variance in the following national procurement policies and procedures scores.

The model results provide additional insights. The inappropriate information systems measure shows no significant results of both regression models for the relationship with service functions are integrated and following national procurement policies and procedures. The inappropriate information systems measure has negative impact in both models but not statistically significant (β = - 0.082, t = - 0.639, p = 0.526; β = - 0.158, t = - 1.270, p = 0.209, respectively).

### 5.6.6 Supplier commercial relationships and focused supply chain integration

**Hypothesis H1f:** Supplier commercial relationships have positive influence on focused supply chain integration.

The results in Table 14.0 provide strong support for this hypothesis. The hypothesis is statistically significant at p = 0.01 level for the relationship between supplier commercial relationships and service functions are integrated ($R^2 = 0.244$, F = 9.199, p = 0.000), with one independent variable, good process integration between suppliers, customers and the DHB, having a positive impact on the dependent variable service functions are integrated ($\beta = 0.384$, t = 2.771, p = 0.008). The reliable suppliers measure shows no significant results in both regression models.

The result is strong for service functions are integrated, with supplier commercial relationships explaining 24.4% of the variance in the service functions are integrated scores.

### 5.6.7 Supply chain integration initiatives and supplier commercial relationships

**Hypothesis H2a:** Supply chain integration initiatives have positive influence on supplier commercial relationships.

The results in Table 15.0 provide support for this hypothesis. The hypothesis is statistically significant at p = 0.05 level for the relationship between supply chain integration initiatives and good process integration between suppliers, customers and the DHB ($R^2 = 0.231$, F = 8.559, p = 0.001), with one independent variable integration with customers, having positive impact on the dependent variable good process integration between suppliers, customers and the DHB ($\beta = 0.543$, t = 3.450, p = 0.001). The cross-functional process within the hospital measure shows no significant results in both regression models.

The result is strong for good process integration between suppliers, customers and the DHB, with supply chain integration initiatives explaining 23.1% of the variance in the good process integration between suppliers, customers and the DHB scores.

### 5.6.8 Organisation strategy and supplier commercial relationships

**Hypothesis H2b:** Organisation strategy and supply chain integration drivers have positive influence on supplier commercial relationships.

The results in Table 16.0 provide strong support for this hypothesis. The hypothesis is statistically significant at p = 0.01 level for the relationship between organisation strategy and SCI drivers and supplier commercial relationships (reliable suppliers measure) ($R^2$ = 0.289, F = 11.593, p = 0.000), with one independent variable, centralised purchasing department, having a strong positive impact on the dependent variable reliable suppliers (β = 0.590, t = 4.813, p = 0.000). The organisation's corporate strategy includes SCI measure shows no significant results in both regression models. The hypothesis is also statistically significant at p = 0.05 level for the relationship between organisation strategy and SCI drivers and supplier commercial relationships (good process integration between suppliers, customers and the DHB measure) ($R^2$ = 0.107, F = 3.408, p = 0.040), with one independent variable, centralised purchasing department, having a positive impact on the dependent variable good process integration between suppliers, customers and the DHB (β = 0.242, 1.760, p = 0.084).

The result is strong for reliable suppliers, with organisation strategy and SCI drivers explaining 28.9% of the variance in the reliable suppliers scores.

### 5.6.9 Performance improvement and supplier commercial relationships

**Hypothesis H2c:** Performance improvement and supply chain integration have positive influence on supplier commercial relationships.

The results in Table 17.0 provide strong support for this hypothesis. The hypothesis is statistically significant at p = 0.01 level for the relationships between performance improvement and SCI and supplier commercial relationships (good process integration between suppliers, customers and the DHB measure) ($R^2$ = 0.258, F = 6.495, p = 0.001), with one independent variable, lowering cost of purchased items, having a strong positive impact on the dependent variable good process integration between suppliers, customers and the DHB (β = 0.563, t = 3.484, p = 0.001). The

ability to handle expected challenges measure shows no significant impact on any supplier commercial relationships measures in both regression models.

The result is strong for good process integration between suppliers, customers and the DHB, with performance improvement and SCI explaining 25.8% of the variance in the good process integration between suppliers, customers and the DHB scores.

The two models also provide additional insights. Lowering cost of purchased items has no significant impact on reliable suppliers. Also, hospital profitability has no significant impact on supplier commercial relationships measures, and it has negative impact on both measures of supplier commercial relationships.

### 5.6.10 Organisation environment forces and supplier commercial relationships

**Hypothesis H2d:** Organisation environment forces have positive influence on supplier commercial relationships.

The results in Table 18.0 do not provide support for this hypothesis. The hypothesis is not statistically significant for the relationship between organisation environmental forces and both reliable suppliers ($R^2 = 0.050$, $F = 1.494$, $p = 0.233$) and good process integration between suppliers, customers and the DHB ($R^2 = 0.007$, $F = 0.213$, $p = 0.809$).

### 5.6.11 Barriers to supply chain integration and supplier commercial relationships

**Hypothesis H2e:** Barriers to supply chain integration have negative influence on supplier commercial relationships.

The results in Table 19.0 provide moderate support for this hypothesis. The hypothesis is statistically significant $p = 0.05$ level for the relationship between barriers to SCI and reliable suppliers ($R^2 = 0.201$, $F = 4.692$, $p = 0.005$), with one independent variable, inappropriate information system, showing a negative impact on

dependent variable reliable suppliers (β = - 0.280, t = - 2.315, p = 0.024). The result is moderately strong for reliable suppliers, with barriers to SCI explaining 20.1% of variance in the reliable suppliers' scores.

The model regression results provide additional insights. Difficult to establish relationships based on shared risks and rewards has negative impact on reliable suppliers but not statistically significant (β = -.472, t = -2.710, p = 0.009).

### 5.6.12 Supply chain integration and influence on order fulfilment

**Hypothesis H3a:** Supply chain integration initiatives have positive influence on order fulfilment.

The regression results in Table 20.0 present moderate support for this hypothesis. The hypothesis is statistically significant at p = 0.01 level for the relationship between supply chain initiatives and collaborative planning, forecasting and replenishment ($R^2$ = 0.126, F= 4.127, p = 0.021), with one independent variable, cross-functional process within the hospital having a moderate positive impact on the dependent variable collaborative planning, forecasting and replenishment (β = 0.243, t = 1.447, p = 0.153).

The result is moderately strong for collaborative planning, forecasting and replenishment, with supply chain integration initiatives explaining 12.6% of the variance in the collaborative planning, forecasting and replenishment scores. The three models also provide further insights. Integration with customers has no significant impact on all measures of order fulfilment.

### 5.6.13 Organisation strategy and order fulfilment

**Hypothesis H3b:** Organisation strategy and supply chain drivers have positive influence on order fulfilment.

The regression results in Table 21.0 provide strong support for this hypothesis. The hypothesis is statistically significant at 0.01 level for the relationship between

organisation strategy and SCI drivers and order fulfilment (classify inventories according to their importance measure) ($R^2 = 0.147$, $F = 4.9$, $p = 0.01$), with two independent variables, organisation's corporate strategy includes SCI, having a strong positive impact on the dependent variable classify inventories according to their importance ($\beta = 0.296$, $t = 2.201$, $p = 0.032$), and another independent variable, centralised purchasing department, having a moderate positive impact on dependent variable ($\beta = 0.150$, $t = 1.117$, $p = 0.269$). The result is strong for classify inventories according to their importance, with organisation strategy and SCI drivers explaining 14.7% of the variance in the classify inventories according to their importance scores.

In addition, the hypothesis is statistically significant at 0.01 level for the relationship between organisation strategy and SCI drivers and collaborative planning, forecasting and replenishment ($R^2 = 0.245$, $F = 9.253$, $p = 0.000$), with independent variable organisation's corporate strategy includes SCI ($\beta = 0.483$, $t = 3.824$, $p = 0.000$). The result is strong for collaborative planning, forecasting and replenishment, with organisation strategy and SCI drivers explaining 24.5% of the variance in the collaborative planning, forecasting and replenishment scores. One of the models provides further insights. Organisation strategy and SCI drivers measure has no significant impact on an effort to control ordering costs. This is an interesting outcome. The relationship was expected to be significant in order fulfilment, but it was not the case with this study.

### 5.6.14 Performance improvement and order fulfilment

**Hypothesis H3c:** Performance improvement and supply chain integration have positive influence on order fulfilment.

The regression results in Table 22.0 provide strong support for this hypothesis. The hypothesis is statistically significant at $p = 0.01$ level for the relationship between performance improvement and SCI, and order fulfilment (classify inventories according to their importance measure) ($R^2 = 0.115$, $F = 2.427$, $p = 0.075$), with one independent variable, ability to handle expected challenges, having a positive impact on the dependent variable classify inventories according to their importance ($\beta = 0.382$, $t = 2.220$, $p = 0.030$). Also, the hypothesis is statistically significant at $p = 0.01$

level for the relationship between performance improvement and SCI and order fulfilment (an effort to control ordering costs measure) ($R^2 = 0.369$, $F = 10.921$, $p = 0.000$), with one independent variable hospital profitability, having a positive impact on the dependent variable an effort to control ordering costs ($\beta = 0.647$, $t = 5.213$, $p = 0.000$). The lowering cost of purchased items measure has negative impact on dependent variable classify inventories according to their importance and shows no significant results in all three models.

The result is moderately strong for classify inventories according to their importance, with performance improvement and SCI explaining 11.5% of the variance in the classify inventories according to their importance scores. The result strong for an effort to control ordering costs, with performance improvement and SCI explaining 36.9% of the variance in an effort to control ordering costs scores.

### 5.6.15 Organisation environment forces and order fulfilment

**Hypothesis H3d:** Organisation environment forces have positive influence on order fulfilment.

The regression results in Table 23.0 furnish moderate support for this hypothesis. The hypothesis is statistically significant at $p = 0.01$ level for the relationship between organisation environmental forces and order fulfilment (collaborative planning, forecasting and replenishment measure) ($R^2 = 0.137$, $F = 4.515$, $p = 0.015$), with one independent variable, customers have initiated integration efforts, having a positive impact on the dependent variable collaborative planning, forecasting and replenishment ($\beta = 0.343$, $t = 2.325$, $p = 0.024$). The suppliers have initiated integration effort measure indicates no significant results in all three regression models for this hypothesis.

The result is moderately strong for order fulfilment (collaborative planning, forecasting and replenishment measure), with organisation environmental forces explaining 13.7% of the variance in the collaborative planning, forecasting and replenishment scores.

### 5.6.16 Barriers to supply chain integration and order fulfilment

**Hypothesis H3e:** Barriers to supply chain integration have negative influence on order fulfilment

The regression results in Table 24.0 provide strong support for this hypothesis. The hypothesis is statistically significant at p = 0.01 level for the relationship between barriers to SCI and order fulfilment (classify inventories according to their importance measure) ($R^2$ = 0.359, F = 10.432, p = 0.000), with one independent variable, difficult to establish relationships based on shared risks and rewards, having a negative impact on the dependent variable classify inventories according to their importance (β = - 0.861, t = - 5.524, p = 0.000). In addition the hypothesis is statistically significant at p = 0.01 level for the relationship between barriers to SCI and order fulfilment (an effort to control ordering costs measure) ($R^2$ = 0.299, F = 7.977, p = 0.000), with two independent variables (lack of willingness to share information having a positive impact (β = 0.516, t = 3.182, p = 0.002) and inappropriate information systems having a negative impact (β = - 0.362, t = - 3.190, p = 0.002).

The results are strong for the order fulfilment (classify inventories according to their importance measure), with barriers to SCI explaining 35.9% of the variance in the classify inventories according to their importance scores, and order fulfilment (an effort to control ordering costs measure) with barriers to SCI explaining 29.9% of the variance in an effort to control ordering costs scores.

### 5.6.17 Supplier commercial relationships and order fulfilment

**Hypothesis H3f:** Supplier commercial relationships have positive influence on order fulfilment.

The regression results in Table 25.0 indicate both strong and moderate support for this hypothesis. The hypothesis is statistically significant at 0.01 level for the relationship between supplier commercial relationships and order fulfilment (collaborative planning, forecasting and replenishment measure) ($R^2$ = 0.222, F = 8.140, p = 0.001), with two independent variables: reliable suppliers (β = 0.302, t = 2.149, p = 0.036)

and good process integration between suppliers, customers and the DHB (β = 0.231, t = 1.647, p = 0.105), having a strong positive impact on the dependent variable collaborative planning, forecasting and replenishment. Furthermore, the hypothesis is statistically significant at 0.05 level moderately supported for the relationship between supplier commercial relationships and order fulfilment (an effort to control ordering costs measure) ($R^2$ = 0.109, F = 3.497, p = 0.037), with one independent variable good process integration between suppliers, customers and the DHB, having a negative impact on the dependent variable an effort to control ordering costs (β = - 0.322, t = - 2.146, p = 0.036).

The result is strong for order fulfilment (collaborative planning, forecasting and replenishment measure), with supplier commercial relationships explaining 22.2% of the variance in the collaborative planning, forecasting and replenishment scores. The result is moderate for order fulfilment (an effort to control ordering costs measure), with supplier commercial relationships explaining 10.9% of the variance in an effort to control ordering costs scores.

### 5.6.18 Focused supply chain integration and order fulfilment

**Hypothesis H3g:** Focused supply chain integration has positive influence on order fulfilment.

The regression results in Table 26.0 provide strong support for this hypothesis. The hypothesis is statistically significant at 0.01 level for the relationship between focused SCI and order fulfilment (collaborative planning, forecasting and replenishment measure) ($R^2$ = 0.164, F= 5.597, p = 0.006), with one independent variable service functions are integrated, having a positive impact on collaborative planning, forecasting and replenishment (β = 0.452, t = 3.345, p = 0.001). Following national procurement policies and procedures measure indicates no significant results in all three regression models for this hypothesis.

The result is strong for order fulfilment (collaborative planning, forecasting and replenishment measure), with focused SCI explaining 16.4% of the variance in the collaborative planning, forecasting and replenishment scores. The positive and

statistically significant impact of focused SCI on order fulfilment (collaborating planning, forecasting and replenishment measure) indicates that public hospitals can improve order fulfilment by focusing on integration of service functions.

Eighteen hypotheses are tested. Sixteen hypotheses are supported and two hypotheses are not supported. The summary results of the hypotheses testing is depicted in Table 7.0.

Table 7.0 Summary of research hypotheses testing results

| Hypothesis | Result |
|---|---|
| **H1a:** Supply chain integration initiatives have positive influence on focused supply chain integration | Supported |
| **H1b:** Organisation strategy and supply chain integration drivers have positive influence on focused supply chain integration. | Supported |
| **H1c:** Performance improvement and supply chain integration have positive influence on focused supply chain integration. | Supported |
| **H1d:** Organisation environment forces have positive influence on focused supply chain integration | Not Supported |
| **H1e:** Barriers to supply chain integration have negative influence on focused supply chain integration | Supported |
| **H1f:** Supplier commercial relationships have positive influence on focused supply chain integration | Supported |
| **H2a:** Supply chain integration initiatives have positive influence on supplier commercial relationships | Supported |
| **H2b:** Organisation strategy and supply chain integration drivers have positive influence on supplier commercial relationships | Supported |
| **H2c:** Performance improvement and Supply chain integration have positive influence on supplier commercial relationships | Supported |
| **H2d:** Organisation environment forces have positive influence on supplier commercial relationships | Not Supported |
| **H2e:** Barriers to supply chain integration have negative influence on supplier commercial relationships | Supported |
| **H3a:** Supply chain integration initiatives have positive influence on order fulfilment | Supported |
| **H3b:** Organisation strategy and supply chain integration drivers have positive influence on order fulfilment | Supported |
| **H3c:** Performance improvement and Supply chain integration have positive influence on order fulfilment | Supported |

Table 7.0 Summary of research hypotheses testing results (cont.)

| Hypothesis | Result |
|---|---|
| **H3d:** Organisation environment forces have positive influence on order fulfilment | Supported |
| **H3e:** Barriers to supply chain integration have negative influence on order fulfilment | Supported |
| **H3f:** Supplier commercial relationships have positive influence on order fulfilment | Supported |
| **H3g:** Focused supply chain integration has a positive influence on order fulfilment | Supported |

## 6.0 Recommendations to enhance SCI in public hospitals

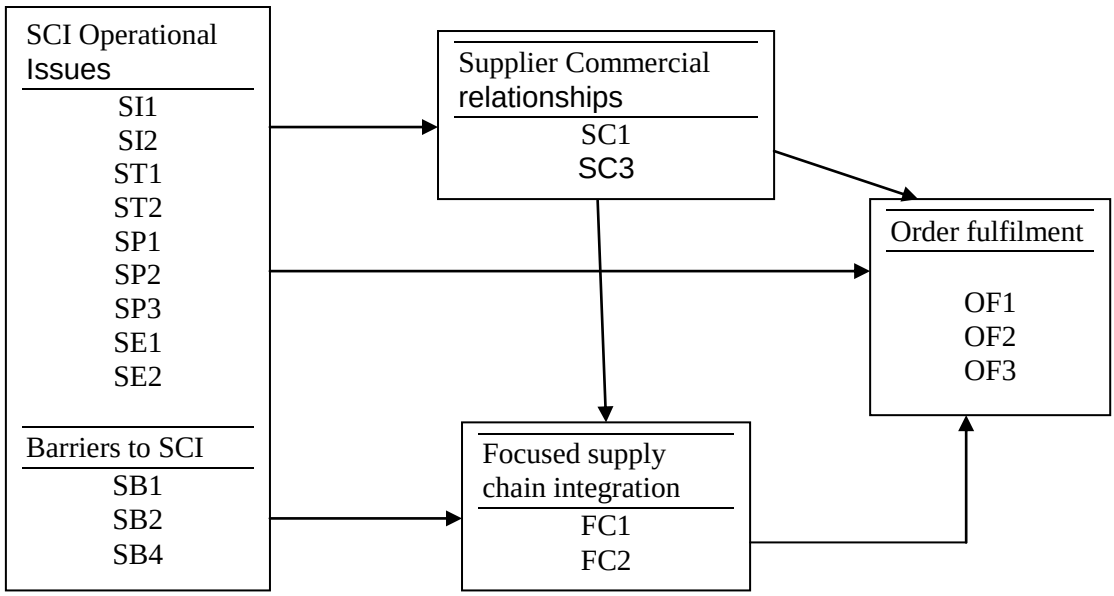
Table 8.0 shows the descriptive statistics of the recommendations which were identified in the main study. Recognising procurement as a strategic function is the most recommendation with the highest mean value of 4.683 (using 5-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). Similar results were achieved in the interviews and the pilot study.

**Table 5.48**

Recommendations to enhance supply chain integration in New Zealand public hospitals

| | Recommendation | Mean | Std. Deviation | Rank |
|---|---|---|---|---|
| RC3 | Recognise procurement as a strategic function | 4.683 | 0.469 | 1 |
| RC1 | Support from top management | 4.367 | 0.758 | 2 |
| RC6 | cement relationships with critical suppliers | 4.267 | 0.733 | 3 |
| RC2 | Collaborations within and between the hospitals | 4.150 | 0.755 | 4 |
| RC5 | Head of procurement must be qualified in supply chain management | 4.003 | 1.008 | 5 |
| RC4 | Head of procurement should report to the Chief executive | 3.517 | 1.347 | 6 |
| RC7 | Top management must be trained in supply chain management | 3.283 | 1.106 | 7 |

**Figure 4.0: Framework/ model for enhancing supply chain integration in NZ public hospital sector**




**Note**: SI1 = Cross-functional process integration

SI2 = Integration with customers

ST1= Organisation's corporate strategy including supply chain integration

ST2= Centralised purchasing department

SP1= Ability to handle expected changes

SP2= Lowering cost of purchased items

SP3= Profitabillity

SE1= Suppliers initiated integration efforts

SE2= Customers initiated integration efforts

SB1= Lack of willingness to share information

SB2= Lack of shared risks and rewards

SB4= Inappropriate information systems

SC1= Reliable suppliers

SC3= Good process integration between suppliers and customers

FC1= Integrated service functions

FC2= National procurement policies and procedures

OF1= Classifying inventories according to their importance

OF2= Collaborative planning, forecasting and replenishment

OF3= An effort to control ordering costs

## 7.0 Discussion of the results and directions for future research

This research developed and empirically tested a model that enhances understanding of the supply chain integration operational issues in the NZ public hospitals and their impact on supplier commercial relationships and order fulfilment, according to the primary objective of the current research discussed in section 1.0. The new mediating factor of focused supply chain integration was examined. In order to answer the research questions, the results of hypotheses testing and evaluation of supply chain integration operational issues, supplier commercial relationships, and focused supply chain integration impact on order fulfilment: the impact of critical operational issues on supplier commercial relationships; the impact of critical operational issues on order fulfilment; the impact of critical operational issues on focused SCI; the impact of supplier commercial relationships on focused SCI; and the impact of supplier commercial relationships on order fulfilment. The constructs of the the research model (Figure 3.0) were tested for reliability and validity. The measurement items were developed based on the literature review and the interviews. The hypotheses were tested using multiple regression analysis and the impact analysis using the correlation matrix.

The results of this research support sixteen hypotheses proposed in the theoretical model and two hypotheses are not supported. In general, the results suggest that supply chain integration operational issues in an organisation, supplier commercial relationships, and focused supply chain integration have positive influence on order fulfilment. However, barriers to supply chain integration, as a component of SCI operational issues, have negative influence on focused supply chain integration supplier commercial relationships, and order fulfilment. The results of two hypotheses not supported in this study show that organisation environmental forces (suppliers or customers have initiated integration effort) do not have significant influence on focused supply chain integration (such as integrated service functions and following national procurement policies and procedures); and also, organisation environmental forces do not have significant influence on supplier commercial relationships

(regarding reliable suppliers and good process integration between suppliers, customers and the DHB). These results of the rejected hypotheses indicate that integration initiated by suppliers or customers do not have impact on the organisation's focused supply chain integration and supplier commercial relationships.

The results of this study are the first to highlight the supply chain integration operational issues and their impact on supplier commercial relationships and order fulfilment in New Zealand public hospitals; similar study is non-existent in the literature. The results are discussed in detail in the following sections.

### 7.1. The influences of supply chain integration operational issues on focused supply chain integration

According to the proposed model (Figure 3.0), this research hypothesised that supply chain integration operational issues have influence on focused supply chain integration. Five hypotheses (H1a, H1b, H1c, H1d, and H1e) were used in the research model. Four hypotheses (H1a, H1b, H1c, and H1e) were found to have strong positive influence on focused supply chain integration. The hypothesis H1d was not supported.

The findings suggest that supply chain integration initiatives, especially integration with customers has strong positive influence on the organisation's integrated service functions (H1a). Therefore, customers have influence on the nature of the service functions integration, this result support (Fawcett and Magnan, 2001). The finding also support Daugherty and Pitman (1995), who stress that organisations should make their operations more flexible and responsive to their customers' requirements and order fulfilment. In addition, organisation strategy and supply chain integration drivers, especially organisation's corporate strategy that includes supply chain integration have strong positive influence on focused supply chain integration factors such as integrated service functions and following national procurement policies and procedures (H1b). The result of H1b support the views of Waller (2003) who stress that the operations of the firm are driven by the strategy of the organisation.

The results of this research identify that performance improvement and supply chain integration have strong positive influence on focused supply chain integration. The emphasis on the organisation's ability to handle expected challenges and lowering cost of purchased items have significant impact on the integrated service functions (H1c). If an organisation wants to reduce the cost of purchased items, it is important to involve all service functions for decision making. The finding of the hypothesis H1c support Sahin and Robinson (2005), who revealed that although information sharing reduces costs, the key benefit comes from coordinated decision making.

Furthermore, the results of this research demonstrate that organisation environement thesis, such as suppliers or customers initiated integration efforts are not predictors of integrated service functions, indicating evidence not to support H1d. The result show that organisation environment forces do not have significant influence on focused supply chain integration variables (integrated service functions and following procurement policies and procedures).

As hypothesized, barriers to supply chain integration have negative influence on focused supply chain integration (H1e). That is, barriers to supply chain integration factors, such as lack of willingness to share information and difficult to establish relationships based on shared risks and rewards, have significant negative impact on focused supply chain integration (integrated service functions and following national procurement policies and procedures). Lin and Huang (2002) argue that information sharing can decrease the demand uncertainty faced by the organisations. Narasimhan and Das (2001) argue that purchasing integration is an internally focused practice while Miller (1982) emphasises the need for alignment between the internal elements of the organisation. These findings are consistent with the result of H1e.

The supply chain integration operational issues adopted from Fawcett and Magnan (2001) have never been linked to the focused supply chain integration, a new construct developed for this study. The findings of this research are the first to provide an empirical insights on the influence of supply chain integration issues on focused supply chain integration in public hospitals. Although some of the SCI operational issues were highly rated in Fawcett and Magnan's (2001) study, this research found

other factors do not have significant influence on focused supply chain integration (see Appendix F: H1a – H1f).

### 7.2 Supplier commercial relationships

In the proposed model, this research hypothesized that supplier commercial relationships have positive influence on focused supply chain integration. The hypothesis H1f result shows that supplier commercial relationships, with emphasis on good process integration between suppliers, customers and the DHB have strong positive influence on focused supply chain integration (integrated service functions). The hypothesis H1f was supported. However, supplier commercial relationships, with emphasis on reliable suppliers only, was found not to have significant influence on focused supply chain integration (service functions are integrated). These findings suggest that the public hospitals and the DHBs use supplier commercial relationships (i.e., good process integration between suppliers, customers and the DHB) to improve focused supply chain integration (i.e., integrated service functions). Also, it might mean that supplier commercial relationships based on good process integration between suppliers and customers have strong positive effect on the customer's organisation (i.e., service functions integration). This relationship reflects the argument by Monzcka et al. (1998) that organisations build strong relationships with suppliers who can meet their requirements and share similar performance objectives. Therefore, the organisation's culture plays an important role in supplier commercial relationships and improvement. Vouzas and Psychogious (2007) emphasise that continuous improvement is for everybody in the organisation.
This study highlights that there is a gap in the literature regarding supply chain integration operational issues influences on supplier commercial relationships in the public hospitals. In order to fill the gap existing in the literature, five hypotheses (H2a, H2b, H2c, H2d, and H2e) were developed and tested (see Appendix B).

The results of this study show that supply chain integration initiatives (i.e., integration with customers) have positive influence on supplier commercial relationships (i.e., good process integration between suppliers, customers and the DHB) (H2a). The result demonstrates that integration with customers (internally or externally) is positively dependent on the good process integration between suppliers, customers

and the DHB. The findings of this research also show that organisation strategy and SCI drivers (i.e., centralised purchasing department) have positive influence on supplier commercial relationships (i.e., reliable suppliers and good process integration between suppliers, customers and the DHB) (H2b). The result confirms the need for an organisation strategy (i.e., centralised purchasing department) in order to enhance supplier commercial relationships (i.e., reliable suppliers and good process integration between suppliers, customers and DHB). This significant relationship supports Narasimhan and Das (2001) who argue that purchasing integration is an internally focused practice and Golicic et al. (2002) who emphasise on relationship management as part of business strategy. It was interesting to find from the results that an organisation's corporate strategy that includes supply chain integration does not have significant influence on supplier commercial relationships (i.e., reliable suppliers). This result supports Fawcett and Magnan (2002) who found that supply chain integration practice does not always resemble the theoretical principle due to difficulty of collaboration.

Furthermore, the results of this research demonstrate that performance improvement and SCI (i.e., lowering cost of purchased items ) has strong positive influence on supplier commercial relationships (i.e., good process integration between suppliers, customers and the DHB) (H2c). This is in agreement with Frohlich and Westbrook (2001). That is, lowering the cost of purchased items strengthens the process integration between suppliers, customers and the DHB. The motive to lower purchasing costs depends on the process integration between suppliers, customers and the DHB. Prahinski and Benton (2004) argue that when a buying organisation uses collaborative communication, the supplier perceives a positive influence on the buyer-supplier relationship. Many authors (e.g., Frohlich & Westbrook, 2001; Narasimhan & Jayaram, 1998; Tan, et al., 1998) have confirmed integration with customers and suppliers in supply chain generates potential benefits. Also, Briscoe (2004) found that clients are key drivers of performance improvement and are the most significant factor in achieving integration in the supply chain. Briscoe's findings are similar to that of Fawcett and Magnan (2001) who found improving customer satisfaction as the dominant motivation to supply chain integration. These views are consistent with support of H2c.

The hypothesis H2d which states that organisation environment forces (i.e., suppliers or customer have initiated integration efforts) have positive influence on supplier commercial relationships (i.e., reliable suppliers and good process integration between suppliers, customers and the DHB) was not supported. It shows that both suppliers and customers initiatives for integration separately do not have impact on supplier commercial relationships.

The hypothesis H2e which states that barriers to supply chain integration have negative influence on commercial relationships was suported. The barriers to supply chain integration, such as inappropriate information system has strong negative influence on supplier commercial relationships (i.e., reliable suppliers). This suggests that bad information system is a significant barrier in maintaining commercial relationships with reliable suppliers. This supports the previous researchers (Fawcett, et al., 2008; Fawcett & Magnan, 2001), who found that inadequate information sharing is a barrier to supply chain integration.

### 7.3 Order fulfilment

According to the proposed model, this research hypothesized that supply chain integration operation issues have influence on order fulfilment. Seven hypotheses (H3a, H3b, H3c, H3d, H3f, and H3g) were found to have strong positive influence on order fulfilment. The hypothesis H3e was found to have strong negative influence on order fulfilment (see Tables 20.0 – 26.0, Appendix B). The findings suggest that supply chain integration initiatives, especially cross-functional process within the hospital has a strong positive influence on order fulfilment (i.e., collaborative planning, forecsting and replenishment) (H3a). The more hospitals have a higher level of cross-functional process within each hospital, the more they are likely to have collaborative planning, forecsting and replenishment (i.e., order fulfilment). The finding suports Hahn et al. (2000) who argue that improved customer satisfaction can be achieved through good integration of functional activities. The importance of cross-functional process as a requirement of an effective plan for order fulfilment was also identified by other researchers (e.g., Davenport & Prusak, 1998; Smith & Farquhar, 2000).

In addition, organisation's strategy that includes suply chain has strong positive influence on order fulfilment (i.e., classifying inventories according to their importance and collaborative planning, forecasting and replenishment) (H3b). This finding is in agreement with the work of Min and Yu (2008) who investigated the collaborative planning, forecasting, and replenishment: demand planning in supply chain management. The implementation of colllaborative planning, forecasting and replenishment aimed at improving collaboration between buyer and supplier has been successful in improving order fill rates (Min & Yu, 2008). The hypothesis H3b also was supported regarding the centralised purchasing department having positive influence on order fulfilment (i.e., classifying inventories according to their importance).

The results of this research identify that performance improvement and supply chain integration have strong positive influence on order fulfilment (H3c). The ability to handle expected challenges and profitability (Fawcett & Magnan, 2001) have strong significant impact on the order fulfilment (i.e., classify inventories according to their importance) and an effort to control ordering costs, respectively. The results also showed an unexpected finding that performance improvement and supply chain integration do have significant influence on order fulfilment (i.e., collaborative planning, forecasting and replenishment) (H3c).

Furthermore, the results of this study demonstrate that organisation environmental forces, such as customers have initiated integration efforts are predictors of order fulfilment (i.e., collaborative planning, forecasting and replenishment), indicating evidence to support H3d. The result confirms the finding of the previous study conducted by Fawcett and Magnan (2001) which revealed customers initiated integration, with higher mean average rating than suppliers initiated integration.

As hypothesized, barriers to supply chain integration have negative influence on order fulfilment (H3e). That is, barriers to supply chain integration factors, such as inappropriate information systems and difficult to establish relationships based on shared risks and rewards, have significant negative influence on order fulfilment (i.e., an effort to control ordering costs and classify inventories according to their importance, respectively). This study supports Fawcett and Magnan (2001) and

Fawcett et al. (2008) who identified inadequate informations systems, as the most barrier to effective supply chain integration in an organisation, followed by lack of shared risks and rewards, and lack or willingness to share information. Surprisingly, this research found that lack of willingness to share information has strong positive significant influence on order fulfilment (i.e., an effort to control ordering costs). The results indicate that lack of willingness to share information is a predictor of an effort to control ordering costs.

As hypothesized, supplier commercial relationships have positive influence on order fulfilment (H3f). That is, commercial relationships variables, such as reliable suppliers and good process integration between suppliers, customers and the DHB, have strong significant positive influence on order fulfilment (i.e., collaborative planning, forecasting and replenishment). This finding is consistent with the literature that claims the importance of supplier - buyer relationships in order fulfilment (e.g., Kritchanchai & MacCarthy, 1999; Thirumalai & Sinha, 2005; Palmatier, 1988; Lambert, 2004; Min & Yu, 2008). The supplier commercial relationships (i.e., good process integration between suppliers, customers, and the DHB) have negative significant influence on order fulfilment (i.e., an effort to control ordering costs), which means that supplier relationships influences the firm's effort to control ordering costs. It means that negative supplier relationships influences an effort to control ordering costs significantly.

It was hypothesized that focused supply chain integration has a positive influence on order fulfilment (H3g). The results support the hypothesis only for collaborative planning, forecasting and replenishment. That is, focused supply chain integration (i.e., service functions are integrated) has strong positive impact on order fulfilment (i.e., collaborative planning, forecasting and replenishment), but do not have significant impact on order fulfilment (i.e., an effort to control ordering costs and classify inventories according to their importance). This is interesting, because an organisation with integrated service functions is expected to control ordering costs and classify inventory effectively. The construct of focused supply chain integration is new and this is the first time to be related to order fulfilment. Further research on the impact of focused supply chain integration on order fulfilment is required to validate the findings of this study.

The results of the hypotheses testing discussed above answers the research questions and fulfil the research objective outlined in sections 1.0. This research makes a contribution to the process-based management theory by examining the supply chain integration operational issues and their impact on commercial supplier relationships and order fulfilment through the new mediating factor of focused supply chain integration. This study provides a comprehensive understanding of supply chain integration, supplier commercial relationships, and order fulfilment in public hospitals in New Zealand.

## 8.0 Contribution from research constructs

### (a) SCI operational issues

The findings of this study suggest that supply chain integration initiatives, especially integration with customers have strong positive influence on the public hospital's integrated service functions. Customers have influence on the nature of the service functions integration. This result supports the findings of Fawcett and Magnan (2001). The finding also support Daugherty and Pitman (1995), who stress that organisaitons should make their operations more flexible and responsive to their customers' requirements and order fulfilment.

Organisation strategy and supply chain integration drivers, especially organisation's corporate strategy that includes supply chain integration have strong positive influence on focused supply chain integration factors, such as integrated service functions and following national procurement policies and procedures. Also, performance improvement and supply chain integration have strong positive influence on focused supply chain integration. The findings of this study demonstrate that the organisation's ability to handle expected challenges and lowering cost of purchased items have significant impact on the integrated service functions. However, Sahin and Robinson (2005) argue that although information sharing reduces costs, the key benefit comes from coordinated decision making.

This study found that organisation environment forces, such as suppliers or customers initiated integration efforts are not predictors of integrated service functions. In addition, organisation environment forces do not have significant

impact on focused supply chain integration (i.e., integrated service functions and following national procurement policies and procedures).

The results of this research show that barriers to supply chain integration (i.e., lack of willingness to share information and difficult to establish relationships based on shared risks and rewards) have significant negative impact on focused supply chain integration (i.e., integrated service functions and following national procurement policies and procedures).

**(b) Supplier commercial relationships**

The study hypothesised that supplier commercial relationships have positive influence on focused supply chain integration. The hypothesis test result shows that supplier commercial relationships, with emphasis on good process integration between suppliers, customers and the DHB have strong positive influence on focused supply chain integration (i.e., integrated service functions). But only supplier commercial relationships with emphasis on reliable suppliers did not have significant influence on focused supply chain integration (i.e., service functions are integrated). These findings suggest that the public hospitals and the DHBs can use supplier commercial relationships (i.e., good process integration between suppliers, customers and the DHB) to improve focused supply chain integration (i.e., integrated service functions).

**(c) Order fulfilment**

Supplier commercial relationships have positive influence on order fulfilment. The commercial relationships variables, such as reliable suppliers and good process integration between suppliers, customers and the DHB, have strong significant positive influence on order fulfilment (i.e., collaborative planning, forecasting and replenishment). This finding supports researches in the literature (e.g., Lambert, 2004; Thirumalai & Sinha, 2005; Min &Yu, 2008). However, supplier commercial relationships (i.e., good process integration between suppliers, customers, and DHB) have negative significant influence on order fulfilment (i.e., an effort to control

ordering costs). This means that supplier commercial relationships can have negative influences on an effort to control ordering costs in the public hospitals.

**8.1 Development and validation of survey instrument**

In addition, this study contributes to theory by the development and validation of a survey instrument and measurement scales for studying supply chain integration operational factors and their impact on commercial relationships and order fulfilment in the public hospital sector. Previous researches in supply chain management have paid less attention to supply chain integration in the public hospital sector, and there is no known valid instrument to measure the linkage of supply integration factors to supplier commercial relationships and order fulfilment in the public hospital sector.

In conclusion, the findings of this study have implications for hospitals implementing SCI, as well as for those hospitals which are in a process of implementing SCI. Hospitals need to consider the use of SCI in order to reduce costs and make more effective use of limited funding, and to improve service level, commercial relationships, and order fulfilment. Furthermore, although this research was conducted in the public hospital sector, the results also have implications for the private hospital sector. In addition, this study enhances the current process-based management theory by adding other critical factors required to be addressed to improve SCI for an organisation (see Figure 4.0), supplier commercial relationships, and order fulfilment. Also, a new focused supply chain integration mediating construct was introduced to facilitate supply chain integration in an organisation. The final model or framework developed as a result of this research is depicted in Figure 4.0. This model adds important critical factors in the literature, which are required for effective SCI in organisations.

**8.2 Managerial implications**

These findings provide many managerial implications. For managers, the importance of understanding the supply chain integration factors and their impact on supplier commercial relationships and order fulfilment, will assist the public

hospitals to have effective supply chain integration internally and externally with the suppliers.

Managers need to consider the following critical supply chain integration operational issues/factors which have influence on supplier commercial relationships and order fulfilment: cross-functional process integration within the hospital, integration with customers, hospitals corporate strategy that includes supply chain integration, establishing centralised purchasing department, ability to handle expected changes, lowering cost of purchased items, hospital profitability, and whether suppliers or customers have initiated integration efforts. Lack of willingness to share information and difficult to establish relationships based on shared risks and rewards are major barriers of supply chain integration.

In addition, managers need to use focused supply chain integration rather than a holistic strategy of supply chain integration. With focused supply chain integration, managers should concentrate more on the factors which are likely to enhance supply chain integration within the hospitals and externally with suppliers. The results of this study identified two critical factors: integrated service factors and following national procurement policies and procedures.

Managers must be careful when deciding on the supplier commercial relationships. There are many different types of supplier relationships, but it is important to select supplier commercial relationships which are beneficial to the hospitals e.g., having reliable suppliers and good process integration between suppliers, customers, and the DHB, which are significant.

The use of purchasing group or centralised procurement in the hospitals create savings (Nollet & Beaulieu, 2005; Burns, 2002; Rozemeijer, 2000; Schneller, 2000; Hendrick, 1997). However, Scanlon (2002, p.1) found that prices negotiated by purchasing groups "were not always lower and were often higher than prices paid by hospitals negotiating with vendors directly". This study results support Scanlon (2002) and it also revealed that having a centralised purchasing department is not significant for an effort to control ordering costs. Therefore, hospitals should be careful in managing centralised purchasing departments in

order to create savings. One of the critical findings from the pilot study interviews, is that the public hospitals and the DHBs have few purchasing and supply personnel trained in procurement at diploma and degree levels. This can cause problems if the centralised purchasing departments will not be managed by trained procurement professionals.

The findings on order fulfilment also provide additional implications. The study results shows that order fulfilment can be improved in the hospitals by classifying inventories according to their importance, having collaborative planning, forecasting and replenishment, and make an effort to control ordering costs. Min and Yu (2008) argue that implementation of collaborative planning, forecasting and replenishment has been successful in minimizing safety stocks, improving order fill rates, increasing sales, and reducing customer response time. Therefore, results of this study are consistent with the findings of Min and Yu (2008). Thus, managers have to pay attention to collaborative planning, forecasting and replenishment in order to fulfil orders effectively.

Furthermore, this study identified three critical barriers to supply chain integration: lack of willingness to share information, difficult to establish relationships based on shared risks and rewards, and inappropriate information systems. Lack of willingness to share information is the most critical barrier of supply chain integration that managers should consider seriously. This finding does not support Fawcett and Magnan (2001) and Fawcett et al. (2008) who found inappropriate information systems as the most critical barrier to supply chain integration. Managers should focus more on the information input in the appropriate information system for an organisation. In order to enhance supply chain integration in the organisation, managers can use the recommendations identified in this study (Table 8.0) and follow the model/ framework (Figure 4.0) to facilitate supply chain integration.

### 8.3 Study limitations

This study, like any research project has limitations.

Firstly, this study included three face to face interview surveys with purchasing and supply executives located in Auckland (a largest city in NZ) public hospitals only, and concentrated on the supply of products and services in the public hospitals. From the interview surveys, the factors influencing supply chain integration, supplier commercial relationships, and order fulfilment were examined. This lead to development of questionnaires for the project. The first questionnaire for the pilot study was sent to 150 purchasing and supply executives, but only 12 usable responses were received. The sample size was small for rigorous statistical analysis. The second questionnaire for the main study was addressed to 350 purchasing and supply chain management personnel in public hospitals, for data collection. Finally, only 60 purchasing and supply executives responded to the survey, with the response rate of 17.14%. The small sample size was not enough for confirmatory factor analysis.

Second, a potential limitation of this study was some respondents' lack of understanding and interpretation of the SCI in their hospitals. The conclusions of the study are based on the reality perceived by a small sample of the respondents and the researcher.

Third, the expected limitation of this study relates to the usefulness of NZ based findings to the international community. The organisational features and practices from a small sample of NZ public hospitals may not have generalisability to the international community.

### 8.4 Conclusion

The primary objective of this research was to develop an empirical understanding of the critical operational factors influencing the supply chain integration and their impact on supplier commercial relationships and order fulfilment in New Zealand public hospitals sector. This objective has been achieved. This study explored critical supply chain integration issues using the process-based management theory (approach) proposed by Lambert (2004, 2008), and conceptualised a new construct of focused supply chain integration as a mediator to order fulfilment.

This research tested eighteen hypotheses using multiple regression analysis. The results of this study support sixteen hypotheses proposed in the theoretical model and two hypotheses are not supported. The major findings of this research are that supply chain integration operational issues in the hospitals, supplier commercial relationships, and focused supply chain integration have positive influence on order fulfilment. Barriers to supply chain integration, as a component of operational issues, have negative influence on focused supply chain integration, supplier commercial relationships, and order fulfilment. The results on two hypotheses not supported in this study show that organisation environmental forces (i.e., suppliers or customers have initiated integration effort) do not have significant influence on focused supply chain (i.e., integrated service functions and following national procurement policies and procedures). Also, organisation environmental forces do not have significance influence on supplier commercial relationships (i.e., reliable suppliers and good process integration between suppliers, customers and the DHB). The results of the rejected hypotheses indicate that integration initiated by suppliers or customers do not have impact on the organisation's focused supply chain integration and supplier commercial relationships.

Most of the critical barriers of supply chain integration identified in this study are consistent with the findings of Fawcett and Magnan (2001) and Fawcett et al. (2008). Magnan (2001) and Fawcett et al. (2008) found inappropriate information systems as the key barrier to effective supply chain integration. In contrast, this research identified lack of willingness to share information as the most barrier to effective supply chain integration in the hospitals.

This research provides a significant contribution to the supply chain integration literature by proposing a new model/framework for enhancing supply chain integration in an organisation. The critical supply chain integration operational factors linkage to supplier commercial relationships, focused supply chain integration, and order fulfilment have been tested for the first time. The results can help researchers and managers to focus on important SCI factors.

Furthermore, researchers and practitioners can use a survey instrument developed and tested in this study for understanding the nature of operational supply chain integration factors and their impact on supplier commercial relationships and order fulfilment in the organisations. This study also provides practitioners with key recommendations to enhance supply chain integration in an organisation, such as recognise procurement as a strategic function, support from top management, and cement relationships with critical suppliers.

This study has increased the understanding of supply chain integration operational factors and their impact on supplier commercial relationships and order fulfilment in New Zealand public hospitals. Although this research was conducted in the public hospital sector, the results also have implications for the private hospital sector and other organisations, which are interested in enhancing supply chain integration, using focused supply chain integration as a mediator for order fulfilment.

### 8.5 Future research

This study provides future research opportunities. The understanding of supply chain integration in NZ public hospital sector can be extended to other public hospitals in the world. In addition, private hospital sector might provide further insights on the nature of supply chain integration operational issues and their impact on commercial supplier relationships and order fulfilment. Also, a study comparing the nature of supply chain integration in public and /or other private hospital sectors can add value to the literature.

An additional future area for research is to study supply chain integration as perceived by operational, middle and senior management in public and private hospitals or other organisations by sector.

An in-depth study using a large sample size is required for future studies in order to perform a confirmatory factor analysis and validate the survey instrument developed in this study. This study used a survey instrument

developed initially from the interviews with three procurement executives and the literature. Future research may start with more interviews.

This study developed measurement items for the supply chain integration operational issues from Fawcett and Magnan (2001) which were similar to the concerns raised in the interviews with the purchasing and supply executives. To improve SCI operational issues, commerical supplier relationships, focused SCI and order fulfilment item measurements, future research should increase the number of interviews with procurement personnel in order to generate more measurement items, and develop an effective SCI measurement instrument or validate the existing ones obtained from the current study. A large sample size must be used to test the measurement instrument.

This study operationalised two (commercial relationship management and order fulfilment) of the eight key supply chain management processes identified by Lambert (2004). Future research could further explore the impact of operational supply chain integration issues on customer relationship, customer service, demand, and returns (reverse) management.

***REFERENCES***


Ahmad, S., & Schroeder, R.G. (2001). The impact of electronic data interchange on delivery performance. Production and Operations Management, 10 (1), 16 – 30.

Akkermans, H.A., Bogerd, P., Yucesan, E., & Wassenhove, L.N.V. (2003). The impact of ERP on supply chain management: exploratory findings from a European Delphi study. European Journal of Operations Research, 146 (2), 284 – 301.

Alexander, J.A., Lichtenstein, R., Jinnett, K., Wells, R., Zazzali, J., & Liu, D. (2005). Cross-functional team processes and patient functional improvement. Health Services Research, 40 (5), 1335-1355.

Alreck, P. I., & Settle, R.B. (2004). The survey research handbook (3rd ed.). New York: McGraw-Hill/Irwin.

Baily, P., Farmer, D., Jessop, D., & Jones, D. (1998). Purchasing principles and management (8th ed.). Essex: Financial Times / Prentice – Hall.

Balan, S., Vrat, P., & Kumar, P. (2007). Reducing the bullwhip effect in a supply chain with fuzzy logic approach. International Journal of Integrated Supply Management, 3 (3), 261 - 282.

Barki. H., & Pinsonneault, (2005, March – April). A model of organizational integration, implementation effort, and performance. Organisation Science, 16 (2), 165 – 179.

Barnes, D., Hinton, M., & Mieczkowska, S. (2003). Competitive advantage through e- operations. Total Quality Management & Business Excellence, 14 (6), p. 659.

Barratt, M., & Oliveira, A. (2001). Exploring the experiences of collaborative planning initiatives. International Journal of Physical Distribution & Logistics Management, 31 (4), 266 – 289.

Barratt, M. (2004). Understanding the meaning of collaboration in the supply chain. Supply Chain Management: An International Journal, 9 (1), 30 – 42.

Barratt, M. (2004). Unveiling enablers and inhibitors of collaborative planning. International Journal of Logistics Management, 15 (1), 73 – 90.

Basu, R., & Wright, J.N. (2008). Total supply chain management. Jordan Hill, Oxford: Elsevier.

Bowersox, D.J., Closs, D.J., & Stank, T.P. (2000). Ten mega-trends that will revolutionize supply chain logistics. Journal of Business Logistics. 21 (2),1-16.

Bowersox, D.J., Closs, D.J., & Stank, T.P. (1999). 21st Century logistics: making supply chain integration a reality, Oak Brook, IL: The Council of Logistics Management.

Bozart, C., & Chapman, S. (1996). A contingency view of time-based competition for Manufacturers. International Journal of Operations & Production Management, 16 (6), 56 - 67.

Braganza, A. (2002). Enterprise integration: creating competitive capabilities. Integrated Manufacturing Systems, 13 (8), 562 – 572.

Breen, L., & Crawford, H. (2005). Improving the pharmaceutical supply chain: Assessing the reality of e-quality through e-commerce application in hospital pharmacy. International Journal of Quality & Reliability Management, 22 (6), 572-590.

Briscoe, G.H., Dainty, A.R., Millet, S.J., & Neale, R.H. (2004). Client-led strategies for construction supply chain improvement. Construction Management and Economics, 22 (2), 193 – 201.

Burnes, B., & New, S. (1997). Collaboration in customer-supplier relationships: strategy, operations and the function of rhetoric. International Journal of Purchasing and Materials Management, 33 (4), 10 - 17.

Burns, L.R. (2002). Role of group purchasing organizations (GPOs), in Burns, L.R. (Ed.). The Health Care Value Chain, San Francisco, CA: John Wiley & Sons, 59 -125.

Burt, D.N. (1989). Managing suppliers up to speed. Harvard Business Review, 64 (4),127.

Burt, D.N., Dobler, D.W., & Starling, S.L. (2003). World class supply management – the key to supply chain management (7th ed.). New York: McGraw-Hill/Irwin, pp. 86-87.

Byrnes, J. (2004, 5 April). Fixing the healthcare supply chain. Working knowledge. Harvard Business School Newsletter, pp. 1-4. Retrieved April 12, 2005, from http://hbsek.edu/dispatch.jhtml? t=dispatch.

Cannon, J.P., & Homburg, C. (2001). Buyers-supplier relationships and customer firm costs. Journal of Marketing, 65 (1), p. 29 - 43.

Carr, A.S., & Pearson, J.N. (1999). Strategically managed buyer- supplier relationships and performance outcomes. Journal of Operations Management, 17, 497-519.

Chan, F.T.S., Chung, S.H., & Choy, K.L. (2006). Optimization of order fulfilment in distribution network problems. Journal of Intelligent Manufacturing, 17 (3), 307-319.

Chen, C-T., & Huang, S-F. (2006). Order-fulfilment ability analysis in the supply-chain system with fuzzy operation times. International Journal of Production Economics, 101 (1), 185 - 193.

Chen, F., Drezner, Z., Ryan, J.K., & Simchi-Levi, D. (2000). Quantifying the Bullwhip effect in a simple supply chain: the impact of forecasting, lead times, and information. Management Science, 46 (3), 436 - 443.

Chen, C-J. (2007). Information technology, organizational structure, and new product development - the mediating effect of cross-functional team interaction. IEEE Transactions on Engineering Management, 54 (4), 687.

Churchill, G.A. (1979). A paradigm for developing better measures of marketing constructs. Journal of Marketing Research, 16 (1), 64 – 73.

Cooper, M.C., Ellram, L.M., Gardner, J.T., & Hanks, A.M. (1997a). Meshing multiple alliances. Journal of Business logistics, 18 (1), 67 – 89.

Cooper, M.C., Lambert, D.M., & Pagh, J.D. (1997b). Supply chain management: more than a new name for logistics. International Journal of Logistics Management, 8 (1), 1 – 14.

Cooper, M.C., & Ellram, L.M. (1993). Characteristics of supply chain management and the implications for purchasing and logistics strategy. International Journal of Logistics Management, 4 (2), 13 - 24.

Corbett, C., & Van Wassenhove, L.V. (1993, Summer). Trade - offs? What trade-offs? Competence and competitiveness in manufacturing strategy. California Management Review, 107 – 122.

Cox, A. (1999). Power, value, and supply chain management. Supply Chain Management: An International Journal, 4 (4), 167-175.

Cox, A., Sanderson, J., & Watson, G. (2001). Supply chains and power regimes: toward an analytic framework for managing supply chain management, 37 (2), 28 – 35.

Croxton, K.L. (2003). The order fulfilment process. International Journal of Logistics Management, 14 (1), 19 - 32.

Crum, C., & Palmatier, G.E. (2004). Demand collaboration: What's holding us back? Supply Management Review, 1 (1), retrieved December 30, 2007, from http://www.scmr.com/article/CA629899.html.

Daft, L.R. (2000). Management (5th ed.). Orlando, Florida: Harcourt College Publishers.

Dainty, A.R.J., Briscoe, G.H., & Millett, S.J. (2001). New perspectives on construction supply chain integration. Supply Chain Management, 4 (3/4), 163 – 173.

Dangayach, G.S., & Deshmukh, S.G. (2001). Manufacturing strategy: literature review and some issues. International Journal of Operations & Production Management, 21 (7), 884 – 932.

Danese, P., Romano, P., & Vinelli, A. (2006). Sequences of improvement in supply networks: case studies from the pharmaceutical industry. International Journal of Operations & Production Management, 26 (11), 1199 – 1222.

Davenport, T.H., & Prusak, L. (1998): Working knowledge: how organizations manage what they know. Boston: Harvard Business Press.

Daugherty, P.J., & Pitman, P.H. (1995). Utilization of time based strategies: creating distribution flexibility/ responsiveness. International Journal of Operations & Production Management, 15 (2), 54 - 60.

Delaney,R.V. (2000, June 4,). Managing logistics in a perfect storm. 12th Annual Press Conference presented at the National Press Club, washington, DC.

Dillman, D.A. (1978). Mail and telephone surveys: the total design method. New York, NY: Wiley.

Dillman, D.A. (2000). Mail and Internet surveys: the tailored design method. New York, NY: Wiley & Sons, Inc.

Dooley, F. (2005). Logistics, inventory control, and supply chain Management. Retrieved December 30, 2007, from http://www.choicesmagazine.org/2005-4/supplychain/2005-4-14.htm.

Doran, D., Thomas, P., & Caldwell, N. (2005). Examining buyer-supplier relationships within a service sector context. Supply Chain Management: An International Journal, 10 (4), 272 - 277.

Duffy, G., & Dale, B.G. (2002). E-commerce processes: a study of criticality. Industrial Management & Systems. 102 (8), 432-441.

Fawcett, S.E., & Magnan, G.M. (2001). Achieving world class supply chain alignment: benefits, barriers and bridges". Centre for Advanced Purchasing Studies, Arizona. Retrieved on April 20, 2007, from http://www.ism.ws

Fawcett, S.E., & Magnan, G.M. (2002). The rhetoric and reality of supply chain integration. International Journal of Physical Distribution & Logistics Management, 32 (5), 339 – 361.

Fawcett, S.E., Magnan, G.M., & McCarter, M.W. (2008). Benefits, barriers, and bridges to effective supply chain management. Supply Chain Management: An International Journal, 13 (1), 35 – 48.

Filippini, R., Forza, C., & Vinelli, A. (1996). Improvement initiative path in operations. Integrated manufacturing Systems, 7 (2), 67 -76.

Filippini, R., Forza, C., & Vinelli, A. (1998). Sequences of operational improvements: some empirical evidence. International Journal of Operations & Production management, 18 (2), 195 - 207.

Forslund, H. (2006). Performance gaps in the dyadic order fulfilment process. International Journal of Physical Distribution & Logistics Management, 36 (8), 580-595.

Forza, C. (2002). Survey research in operations management: a process-based perspective. International Journal of Operations & Production Management, 22 (2), 152-194.

Fowler, F.J., Jr (2002). Survey Research Methods (3rd ed.). Thousand Oaks, California: Sage Publications, Inc., 71 – 73.

Frohlich, M.T. (2002). E-integration in the supply chain: barriers and performance. Decision Sciences, 33 (4), 537 – 556.

Frohlich, M.T., & Westbrook, R. (2001). Arcs of integration: an international study of supply chain strategies. Journal of Operations Management, 19 (2), 185 - 200.

Frohlich, M.T., & Westbrook, R. (2002). Demand chain management in manufacturing and services: web-based integration drivers, and performance. Journal of Operations Management, 20, (6), 729-745.

Fry, T. (1990). Controlling input: the real key to shorter lead times. The International Journal of Logistics Management, 1 (1), 7 - 12.

Ganesan, S. (1994, April). Determinants of long-term orientation in buyer-seller relationships. Journal of Marketing, 58,1-19.

Garson, G.D. (2008). Regression: Statnotes, from North Carolina State University. Retrieved September 10, 2009, from http://faculty.chass.ncsu.edu/garson/PA765/regress.htm.

Goldman, S.L., Nagel, R.N., & Preiss, K. (1995). Agile competitors and virtual organization: strategy for enriching the customer. New York: Van Nostrand Reinhold.

Golicic, S.L., Davis, D.F., McCarthy, T.M., & Mentzer, J.T. (2002). The impact of e-commerce on supply chain relationships. International Journal of Physical Distribution & Logistics Management, 32 (10), 851-871.

Hahn, C.K., Duplaga, E.A., & Hartley, J.L. (2000). Supply Chain synchronization: lessons from Hyundai Motor Company. Interfaces, 30 (4), 32 - 45.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., & Tatham, R.L. (2006). Multivariate Data Analysis (5th ed.). New Jersey: Prentice-Hall.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., & Tatham, R.L. (1998). Multivariate Data Analysis (6th ed.). New Jersey: Prentice-Hall.

Halldorsson, A., Larson, P.D., & Poist, R.F. (2008). Supply chain management: a comparison of Scandinavian and American perspectives. International Journal of Physical Distribution & Logistics Management, 38 (2), 126 – 142.

Hammer, M. (2001). The super efficient company. Harvard Business Review, 79 (8), 82 - 91.

Handfield, R.B. & Nichols, E.L. Jr. (2002). Supply chain redesign transforming supply chains into integrated value systems. New Jersey: Prentice-Hall, p. 8.

Hanna, J.D., Groot, G.D., Loo, E., & Ypenburg, M. (2003). Flows of good or supply chains: lessons from the natural rubber industry in Kerala, India. International Journal of Production Economics, 81/82, 185 - 194.

Hendrick, T.E. (1997). Purchasing consortiums: horizontal alliance among firms buying common goods and services: what? who? how? Tempe, Arizona: Center for Advanced Purchasing Studies (CAPS) Research.

Hill, C.A., & Scudder, G.D. (2002). The use of electronic data interchange for supply chain coordination in the food industry. Journal of Operations Management, 20, 375-387.

Hoek, R.I.V., & Weken, H.A.M. (1998). The impact of modular production on the dynamics of supply chains. International Journal of Logistics Management, 9 (2), 35 - 50.

Hui, L.T. (2004). Business timeliness: the intersections of strategy and operations management. International Journal of Operations & Production Management, 24(5/6), 605 - 624.

Johnson, G., & Scholes, K. (2002). Exploring corporate strategy – text and cases (6th ed.). Harlow, Essex: Prentice Hall.

Jonsson, P., & Zineldin, M. (2003). Achieving high satisfaction in supplier-dealer working relationships. Supply Chain Management, 8 (3/4), 224 - 240.

Johnston, D.A., McCutcheon, D.M., Stuart, F.I., & Kenwood, H. (2004). Effects of supplier trust on performance of cooperative supplier relationships. Journal of Operations Management, 22 (1), 23 – 38.

Kim, S.W., & Narasimhan, R. (2002). Information system utilization in supply chain integration efforts. International Journal of Production Research, 40 (18), 4585 - 4609.

Kim, S.W. (2006a). The effect of supply chain integration on the alignment between corporate competitive capability and supply chain operational capability. International Journal of Operations & Production Management, 26 (10), 1084 – 1107.

Kim, S.W. (2006b). Effects of supply chain management practices, integration and competition capability on performance. Supply Chain Management, 11 (3), 241 – 248.

King, R., & Phumpiu, P. (1996). Reengineering the food supply chain: The ECR initiative in the grocery industry. American Journal of Agricultural Economics, 78, 1181 - 1186.

Kline, R. B. (2005). Principles and practice of structural Equation Modelling (2nd ed.). New York: The Guilford Press.

Kritchanchai, D., & MacCarthy, B.L. (1999). Responsiveness of the order fulfilment process. International Journal of Operations & Production Management, 19 (8), 812-833.

Kwon, I.G., & Suh, T. (2005). Trust, commitment and relationships in supply chain management: a path analysis. Supply Chain Management: An International Journal, 10 (1), 26-33.

La Londe, B. (2002, May/June ). Who can you trust these days? Supply Chain Management Review, p.10.

Lambert, D.M. (2004). The eight essential supply chain management processes. Supply Chain Management Review, 8 (6), 18 - 26.

Lambert, D.M. (2008). Supply chain management: processes, partnerships, performance. Sarasota, Florida: Supply Chain Management Institute.

Lambert, D.M., Cooper, M.C., & Pagh, J.D. (1998a). Supply chain management: implementation issues and research opportunities. The International Journal of Logistics Management, 9 (2), 1-20.

Lambert, D.M., Stock, J.R., & Ellram, L.M. (1998b). Fundamentals of logistics management, Boston, MA: Irwin/McGraw-Hill.

Lambert, D.M., & Cooper, M.C. (2000). Issues in supply chain management: implementation issues and research opportunities. Industrial Marketing Management, 29, 65 -83.

Lau, G.T., & Goh, M. (2005). Buyer – seller relationships in the PCB industry. Supply Chain Management, 10 (4), 302 -12.

Lee, H.L., Padmanabhan, V., & Whang, S. (2004). Information distortion in a supply chain: the bullwhip effect. Management Science, 50 (12), 1875 -1886.

Lee, H.L., & Billington, C. (1992, Spring). Managing supply chain inventory: pitfalls and opportunities. Sloan Management Review, 65 – 73.

Lee, H., & Whang, S. (1999, Fall). Supply chain integration in the age of e-business. Supply Chain Management review, 16-19.

Lee, H.L. (2000, September/ October). Creating value through supply chain integration. Supply Chain Management Review, 30-36.

Lee, H.L. (2000, June ). Reducing costs through the supply chain quoted by John Yuva in Purchasing Today, 48-63.

Lee, H.L., & Wolfe, M. (2003, January/February ). Supply chain security without tears. Supply Chain Management Review, 12-20.

Lee, H.L, So, K.C., & Tang, C.S. (2000). The value of information sharing in a two - level supply chain. Management Science, 46 (5), 626 - 643.

Li, S. (2002). An integrated model for supply chain management practice, performance and competitive advantage, Doctoral Dissertation, University of Toledo, Toledo, OH.

Lin, C., & Tseng, H. (2006). Identifying the pivotal role of participation strategies and information technology application for supply chain excellence. Industrial Management and Data Systems, 106 (5), 739 -756.

Lin, F., Huang, S-H., & Lin, S-C. (2002). Effects of information sharing on supply chain performance in electronic commerce. IEEE Transactions on Engineering Management, 49(3), 258 - 268.

Loebbecke, C. (2007). Adopting IT for content integration in the supermarket: The METRO Systems, 16 (2), 228 – 236.

Logistics Bureau (2007). Inventory management for the supply chain. Retrieved December 30, 2007, from http://logistics.about.com/od/inventorymanagement/Inventory_Management_for_the_supply_chain.html.

Lowson, R.H. (2003). How supply network operations strategies evolve: composition, competitive priorities and customization. International Journal of Physical Distribution & Logistics Management, 33 (1), 75 – 91.

Lummus, R.R., Krumwiede, D., 7 Vokurka, R.J. (2001). The relationship of logistics to supply chain management: developing a common industry definition. Industrial Management & Data Systems, 101 (8), 426 – 432.

Marston, C., & Straker, M. (2001). Investor relations: a European survey. Corporate Communications: An International Journal, 6 (2), 82 - 93.

Martensen, A., & Dahlgaard, J.J. (1999). Strategy and planning for innovation management – a business excellence approach. International Journal of quality & reliability Management, 16 (8), 734 – 755.

McAfee, A. (2002). The impact of enterprise information technology adoption on operational performance: an empirical investigation. Production and Operations Management, 11 (1), 33 - 53.

Marquez, A.C., Bianchi, C. & Gupta, J.N.D. (2004). Operational and financial effectiveness of e-collaboration tools in supply chain integration. European Journal of Operational Research, 159 (2), 348 - 363.

Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D., & Zacharia, Z.G. (2001). Defining supply chain management. Journal of Business logistics, 22 (2), 1 -25.

Middlemore Hospital (2006, September 13). Personal communication on the supply chain network in the public hospitals.

Miller, D. (1982). Evolution and revolution: a quantum view of structural change in organizations. Journal of Management Studies, 19 (2), 131-151.

Min, H., & Yu, W. (2008). Collaborative planning, forecasting, and replenishment: demand planning in supply chain management. International Journal of Information Technology and Management, 7 (1), 4 - 20.

Ministry of Health in New Zealand (2008). Retrieved on 16 May, 2008, from http://www.moh.govt.nz

Mollenkopf, D., Russo, I., & Frankel, R. (2007). The returns management process in supply chain strategy. International Journal of Physical Distribution & Logistics Management, 37 (7), 568 - 592.

Monzcka, R.M., Petersen, K.J., Handfield, R.B., & Ragatz, G.L. (1998). Success factors in strategic supplier alliances: the buying company perspective. Decision Sciences, 29(3), 553 - 576.

Morash, E.A. (2001). Supply chain strategies, capabilities, and performance. Transportation Journal, 41 (1), 37 – 54.

Mullins, L.J. (2002). Management and organisational behaviour (6th ed.). Harlow, Essex: Prentice – Hall.

National Research Council. (2000). Surviving supply chain integration: strategies for small manufacturers. The National Academy of Sciences, p. 27.

Narasimhan, R., & Kim, S.W. (2002). Effect of supply chain integration on the relationship between diversification and performance: evidence from Japanese and Korean firms. Journal of Operations Management, 20 (3), 303 – 23.

Narasimhan, R., Jayaram, J., & Carter, J.R. (2001). An empirical examination of the underlying dimensions of purchasing competence. Production and Operations Management, 10 (1), 1-15.

Narasimhan, R., & Jayaram, J. (1998). Casual linkages in supply chain management. an exploratory study of North American manufacturing firms. Decision Sciences, 29 (3), 579 - 605.

Narasimhan, R., & Das, A. (1999). An empirical investigation of the contribution of strategic sourcing to manufacturing flexibillities and performance. Decision Sciences, 30 (3), 683-718.

Narasimhan, R. & Das, A. (2001). The impact of purchasing integration practices on manufacturing performance. Journal of Operations Management, 19, 593 - 609.

Narus, J.A., & Anderson, J.C. (1996). Rethinking distribution: adaptive channels. Harvard Business Review, 74 (4), 112-120.

Nollet, J., & Beaulieu, M. (2005). Should an organisation join purchasing group? Supply Chain Management: An International Journal, 10 (1), 11-17.

Novelli, B. (2004,16 August). The promise and the reality. Modern healthcare (Chicago), 34 (32).

Okoroh, M.I., Gombera, P.P., & Ilozor, B.D. (2002). Managing FM (support services): business risks in the healthcare sector. Facilities, 20 (1/2), 41-51.

Palmatier, G.E. (1988). Reducing uncertainties in demand. APICS Conference Proceedings,102 -107.

Pan, Z.X., & Pokharel, S. (2007, p. 195). Logistics in hospitals: a case study of some Singapore hospitals. Leadership in Health Services, 20 (3), 195 – 207.

Petersen, C.G., & Aase, G. (2004). A comparison of picking, storage, and routing policies in manual order picking. International Journal of Production Economics, 92 (1), 11-19.

Pint, E.M., & Baldwin, L.H. (1997). Strategic sourcing: theory and evidence from economics and business management. Document MR – 865 – AR. Santa Monica, CA: The RAND Corporation.

Raps, A. (2005). Strategy implementation – an insurmountable obstacle? Handbook of Business Strategy, 6 (1), 141 – 146.

Quayle, M. (2003). A study of supply chain management practice in UK industrial SMEs. Supply Chain Management: An International Journal, 8 (1), 79 - 86.

Prahinski, C., & Benton, W.C. (2004). Supplier evaluations: communication strategies to improve supplier performance. Journal of Operations Management, 22, 39-62.

Ragatz, G.L., Handfield, R.B., & Scannel, T.V (1997). Success factors for integrating suppliers into new product development. Journal of Product Innovation Management, 14 (3), 190 - 202.

Rai, A., Patnayakuni, R., & Seth, N. (2006). Firm performance impacts of digitally enabled supply chain integration capabilities. MIS Quartery, 30 (2), 225 – 246.

Rosemeijer, F. (2000). How to manage corporate purchasing synergy in a decentralised company? Towards design rules for managing and organising purchasing synergy in decentralised companies. European Journal of Purchasing & Supply Management, 6 (1), 5 – 12.

Rosenweig, E.D., Roth, A.V., & Dean, J.W. (2003). The influence of an integration strategy on competitive capabilities and business performance: an exploratory study of consumer products manufacturers. Journal of Operations Management, 21 (4), 437-456.

Rossi, P.H., Wright, J.D., & Anderson, A.B. (1983). Handbook of survey research. New York, NY: Academic Press.

Sahin, F. & Robinson, E.P. (2005). Information sharing and coordination in make-to-order supply chains. Journal of Operations Management, 23 (6), 579 - 598.

Scanlon, W.J. (2002). Group purchasing organisations: pilot study suggests large buying groups do not always offer hospitals lower prices. United States General Accounting Office. Retrieved January 15, 2006, from http://www.gao.gov/new.items/do2690t.pdf

Schneller, E.S. (2000). The value of group purchasing in the health care supply chain, Tempe, AZ: School of Health Administration and Policy. In Nollet & Beaulieu (2005).

Sethi, R., Smith, D.C., & park, C.W. (2001). Cross-functional product development teams, creativity, and the innovativeness of new consumer products. Journal of Marketing Research, 38 (10), 73-85.

Shapiro, J.F. (2001). Modelling the supply chain. CA: Thomson Learning.

Shapiro, B.P., Rangan, V.K & Sviokla, J.J (1992, July - August). Staple yourself to an order. Harvard Business Review, 113-22.

Sheu, C., Yen, H.R., & Chae, B. (2006). Determinants of supplier-retailer collaboration: evidence from an international study. International Journal of Operations & Production Management, 26(1), 24 - 49.

Sislian, E., & Satir, A. (2000). Strategic sourcing: a framework and a case study. The Journal of Supply Chain Management, 36 (3), 4 - 11.

Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2003). Designing and managing the supply chain: concepts, strategies, and case studies (2nd ed.). Boston: Irwin/McGraw-Hill, p. 7.

Smith, R.G., & Farquhar, A. (2000). The road ahead for knowledge management. AI Magazine, 21 (4), 17- 40.

Spitzberg, B.H. (2000). What is good communication? Journal of the Association for Communication Administration, 29, 103 - 119, in Adler, R.B., Rosenfeld, L.B. & Proctor II, R.F (2007). Interplay: the process of interpersonal communication (10th ed.). New York: Oxford University Press, p. 20.

Stank, T.P., Keller, S.B., & Closs, D.J. (2001). Performance benefits of supply chain logistical integration. Transportation Journal, 41 (2/3), 32-46.

Stephens, S. (2001). Supply chain operations model version 5.0: A new tool to improve supply chain efficiency and achieve best practices. Information Systems Frontiers, 3 (4), 471.

Stewart, G. (1997). Supply-chain operations reference model (SCOR): the first cross-industry framework for integrated supply-chain management. Logistics Information Management, 10 (2), 62-67.

Stevens, G. (1990). Successful supply chain management. Management Decision, 28 (8), 25 – 30.

Stock, G.N. & Tatikonda, M.V. (2000). A typology of project – level technology transfer processes. Journal of Operations Management, 18 (6), 719 - 737.

Stratman, J.K. (2007). Realizing benefits from enterprise resource planning: does strategic focus matter? Production and Operations Management, 16 (2), 203 – 216.

Sundarraj, R.P., & Talluri, S. (2003). A multi-period optimization model for the procurement of component-based enterprise information technologies. European Journal of Operations Research, 146 (2), 339 – 351.

Supply Chain Council. (n.d.). SCOR model. Retrieved July 14, 2006, from http://www.supply-chain.org/page.ww?section=SCOR+Model& name=SCOR+Model.

Supply chain council. (2001). Supply-chain operations. Reference-model: Overview of SCOR version 5.0.

Supply-Chain Council (2003). Supply-Chain Operations Reference –model. Overview of SCOR version 6.0.

Szwejczewski, M., Lemke, F., & Goffin, K. (2005). Manufacturer – supplier relationships: an empirical study of German manufacturing companies. International Journal of Operations & Production Management, 25 (9), 875 – 897.

Tabachnick, B. G., & Fidell, L. S. (2001). Using multivariate statistics (4th ed.). Boston: Allyn and Bacon.

Tan, K.C., Kannan, V.R., & Handfield, R.B. (1998). Supply chain management: supplier performance and firm performance. International Journal of Purchasing and Materials Management, 34 (3), 2 - 9.

Task Force Report on Supply Chain Management (2001, November). Improving Supply Chain Management for Better Health Care. A Joint Initiative of the Ontario Hospital Association and Efficient Healthcare Consumer Response. Retrieved 20 August, 2005, from http://www.ontariobudget.fin.gov.on.ca.

Thirumalai, S., & Sinha, K.K. (2005). Customer satisfaction with order fulfilment in retail supply chains: implications of product in electronic B2C transactions. Journal of Operations Management, 23 (3, 4), 291-303.

Towill, D.R., Childerhouse, P., & Disney, S.M. (2000). Speeding up the progress curve towards effective supply chain management. Journal of Supply Chain Management, 5 (3), 122-130.

Towill, D.R., & Christopher, M. (2005). An evolutionary approach to the architecture of effective healthcare delivery systems. Journal of Health, Organisation and Management, 19 (2), 130-147.

Ulaga, W., & Eggert, A. (2006). Value-based differentiation in business relationships: gaining and sustaining key supplier status. Journal of Marketing, 70 (1), 119 -136.

Van der Vaart, T., & Van Donk, V. (2004). Buyer focus: evaluation of a new concept for supply chain integration. International Journal of Production Economics, 92 (1), 21 – 30,

Van Donk, D.P., Akkerman, R., & Van der Vaart, T. (2008). Opportunities and realities of supply chain integration: the case of food manufacturers. British Food Journal, 110 (2), 218 – 235.

Van Hoek, R.I. (1998a). Reconfiguring the supply chain to implement postponed manufacturing. International Journal of Logistics Management, 9 (1), pp. 95 -110.

Van Hoek, R.I. (1998b). Measuring the unmeasurable-measuring and improving performance in the supply chain. Supply Chain Management, 3 (4), pp.187 -192.

Van Hoek, R.I., Harrison, A., & Christopher, M. (2001). Measuring agile capabilities in the supply chain. International Journal of Operations & Production Management, 21 (1/2), 126 – 148.

Venkatachalam, A.R. (2006). A holistic perspective on enterprise integration. Journal of Information Technology Case and Application Research, 8 (1), 1 - 6.

Viswanathan, S., & Piplan, R. (2001). Coordinating supply chain inventories through common replenishment epochs. European Journal of Operational Research, 129, 277 - 286.

Vouzas, F., & Psychogios, A.G. (2007). Assessing managers' awareness of TQM. The TQM Magazine, 19 (1), 62 – 75.

Wagner, S.M. (2003). Intensity and managerial scope of supplier integration. Journal of Supply Chain Management, 39 (4), 4 – 15.

Walker, G. (1988). Strategic sourcing, vertical integration, and transaction costs. Interfaces, 18 (3), 62.

Waller, D.L. (2003). Operations management: a supply chain approach (2nd ed.). London: Thomson Learning.

Wilson, R. (2004). 15th Annual state logistics report. Council of Supply Chain management Professionals. Retrieved 21 August, 2005, from http://www.cscmp.org/.

Wu, Z., & Choi, T.Y. (2005). Supplier - supplier relationships in the buyer-supplier triad: building theories from eight case studies. Journal of Operations Management, 24 (1), 27 - 52.

Yin, R.K. (2003). Case study research: design and methods. Thousand Oaks, California: Sage Publications, Inc.

Yusuf, Y.Y., Gunasekaran, A., Adele, E.O., & Sivayoganathan, K. (2004). Agile supply chain capabilities: determinants of competitive objectives, European Journal of Operational research, 159 (2), 379 -392.

Zailani, S., & Rajagopal, P. (2005). Supply chain integration and performance: US versus East Asian companies. Supply Chain Management: An international Journal, 10 (5), 379 – 393.

Zhang, Z., & Sharifi, H. (2000). A methodology for achieving agility in manufacturing organizations. International Journal of Operations and Production Management, 20 (4), 496 - 512.

Zikmund, W.G. (2000). Exploring marketing research (7th ed.). Orlando, Florida: Harcourt Brace & Company.

**APPENDIX A:** ***Survey Questionnaire (Main Study)***

***Supply chain integration in New Zealand public hospitals: impact on supplier commercial relationships and order fulfilment***

**SECTION A: SUPPLY CHAIN INTEGRATION OPERATIONAL ISSUES**

**1. To what extent is your hospital actively engaged in supply chain integration initiatives?**

| | Not totally engaged | Not engaged | Neutral | Engaged | Totally engaged |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. Cross-functional process integration within the hospital | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. Integration with customers | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. Integration first-tier suppliers | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. Complete customers and suppliers supply chain integration | ❑ | ❑ | ❑ | ❑ | ❑ |

**2. Please tick the number that best reflects your agreement with the following statements concerning supply chain integration in your hospital.**

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. Our organisation's corporate strategy includes supply chain integration | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. We have a centralised purchasing department | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. Our organisation promotes integration through use of information technology | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. Lowering costs is a core driver of our supply chain integration | ❑ | ❑ | ❑ | ❑ | ❑ |
| e. Improving service level is another core driver influencing our supply chain integration in our hospital | ❑ | ❑ | ❑ | ❑ | ❑ |

**3. To what extent has supply chain integration improved your hospital's performance in the following areas?**

Degree of performance improvement

| | Not greatly improved | Not improved | Neutral | Improved | Greatly improved |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. Ability to handle expected challenges | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. Lowering cost of purchased items | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. Hospital profitability | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. Inventory costs | ❑ | ❑ | ❑ | ❑ | ❑ |
| e. On-time delivery/Due-date performance | ❑ | ❑ | ❑ | ❑ | ❑ |
| f. Order fulfilment lead times | ❑ | ❑ | ❑ | ❑ | ❑ |
| g. Overall customer satisfaction | ❑ | ❑ | ❑ | ❑ | ❑ |
| h. Responsiveness to customer requests | ❑ | ❑ | ❑ | ❑ | ❑ |
| i. Total productivity | ❑ | ❑ | ❑ | ❑ | ❑ |

**4. To what extent has the following led your hospital to seek greater supply chain integration?**

Importance of environmental forces

| | Not a critical factor | Not a factor | Neutral | Is a factor | Is a critical factor |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. Suppliers have initiated integration effort | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. Customers have initiated integration efforts | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. Desire to lower supply chain costs | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. Desire to focus on core competence in services | ❑ | ❑ | ❑ | ❑ | ❑ |

**5.To what extent do the following act as barriers to supply chain integration in your hospital?**

Degree to which each acts as a barrier to supply chain integration

| | Is not a serious barrier | Is not a barrier | Neutral | Is a barrier | Is a serious barrier |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. A lack of willingness to share information | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. Difficult to establish relationships based on shared risks and rewards | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. Difficulty to evaluate contribution of each supply chain member | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. Inappropriate information systems | ❑ | ❑ | ❑ | ❑ | ❑ |
| e. Inconsistent operating goals | ❑ | ❑ | ❑ | ❑ | ❑ |
| f. Budget limitation for supply chain resources | ❑ | ❑ | ❑ | ❑ | ❑ |
| g. Lack of suppliers to comply with agreed key performance indicators (KPIs) | ❑ | ❑ | ❑ | ❑ | ❑ |
| h. Government procurement policies and procedures | ❑ | ❑ | ❑ | ❑ | ❑ |
| i. Organisational boundaries prevent integration | ❑ | ❑ | ❑ | ❑ | ❑ |

**SECTION B: SUPPLIER COMMERCIAL RELATIONSHIPS**

**6. Please tick the number that best reflects your agreement with the following statements concerning supplier commercial relationships in your hospital.**

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. We have reliable suppliers | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. We promote partnership with dedicated suppliers | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. We have good process integration between suppliers, customers, and the DHB | ❑ | ❑ | ❑ | ❑ | ❑ |

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| d. We have joint or collaborative planning | ❑ | ❑ | ❑ | ❑ | ❑ |
| e. We make effective negotiations with suppliers | ❑ | ❑ | ❑ | ❑ | ❑ |
| f. We use KPIs in judging our suppliers | ❑ | ❑ | ❑ | ❑ | ❑ |
| g. We have a service level agreement | ❑ | ❑ | ❑ | ❑ | ❑ |
| h. We use a contract to maintain relationship | ❑ | ❑ | ❑ | ❑ | ❑ |
| i. We have single source relationships | ❑ | ❑ | ❑ | ❑ | ❑ |

**SECTION C: FOCUSED SUPPLY CHAIN INTEGRATION**

**7. Please tick the number that best reflects your agreement with the following statements concerning supply chain integration in your hospital.**

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. Our service functions are integrated | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. We follow national procurement policies and procedures | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. We use Enterprise Resource Planning (ERP) system | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. We use an online purchasing system | ❑ | ❑ | ❑ | ❑ | ❑ |
| e. Top management is committed to supply chain integration | ❑ | ❑ | ❑ | ❑ | ❑ |
| f. We have good organisational culture that supports supply chain integration | ❑ | ❑ | ❑ | ❑ | ❑ |
| g. Our organisation structure is good for internal supply chain integration | ❑ | ❑ | ❑ | ❑ | ❑ |

**SECTION D: ORDER FULFILMENT**

**8. Please tick the number that best reflects your agreement with the following statements concerning order fulfilment in your hospital.**

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. We classify inventories according to their importance* | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. We have collaborative planning, forecasting and replenishment (CPFR) | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. We make an effort to control ordering costs | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. Suppliers have capacity to meet the demand | ❑ | ❑ | ❑ | ❑ | ❑ |
| e. We have capacity to respond to demand fluctuations | ❑ | ❑ | ❑ | ❑ | ❑ |
| f. Suppliers (vendors) manage our inventory | ❑ | ❑ | ❑ | ❑ | ❑ |
| g. We do maintain high levels of emergency supplies | ❑ | ❑ | ❑ | ❑ | ❑ |
| h. We emphasize to suppliers that accuracy and efficiency of order fulfilment is important | ❑ | ❑ | ❑ | ❑ | ❑ |

***** Importance means: (critical, important, and non-critical).

**SECTION E: SUPPLIER SELECTION AND INTEGRATION**

**9. Please rate your hospital's supplier selection factors on a scale of 1 – 5 (1 : not very important and 5 : very important) (tick the number).**

| | Not very important | Not important | Neutral | Important | Very important |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. Cost | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. Past experience of reliability | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. Lead time | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. Quality | ❑ | ❑ | ❑ | ❑ | ❑ |
| e. Customer service (specialist advice) | ❑ | ❑ | ❑ | ❑ | ❑ |
| f. Response speed | ❑ | ❑ | ❑ | ❑ | ❑ |

**10. Please tick the number that best reflects your agreement with the following statements concerning recommendations to enhance supply chain integration in hospitals and DHBs.**

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| a. Support from top management | ❑ | ❑ | ❑ | ❑ | ❑ |
| b. Collaboration within and between the hospitals | ❑ | ❑ | ❑ | ❑ | ❑ |
| c. Recognise procurement as a strategic function | ❑ | ❑ | ❑ | ❑ | ❑ |
| d. Head of procurement should report to the chief executive | ❑ | ❑ | ❑ | ❑ | ❑ |
| e. Head of procurement must be qualified in supply chain management | ❑ | ❑ | ❑ | ❑ | ❑ |
| f. Cement relationships with critical suppliers | ❑ | ❑ | ❑ | ❑ | ❑ |
| g. Top management must be trained in supply chain management | ❑ | ❑ | ❑ | ❑ | ❑ |

**SECTION F: GENERAL INFORMATION**

1. Your position / title: ……
2. Place of work: Hospital ❑ DHB ❑
3. Gender: Male ❑ Female ❑
4. Your highest qualification: Degree ❑ Diploma ❑ Certificate ❑
5. Your procurement responsibility (tick the appropriate box):

   ☐ General requirements ☐ Theatre requirements

6. Number of employees in purchasing and supply department
7. Number of key suppliers ☐
8. Annual value of purchases (year 2007/8): NZ$ ……
9. Our hospital buys products and services (tick the appropriate box):

   ☐ direct from the external supplier

   ☐ through agents

**THANK YOU FOR YOUR TIME AND ASSISTANCE**

**Appendix B: Hypotheses testing results (Tables 9.0 – 26.0)**

**Table 9.0: Hypothesis testing for Hla**
**Regression results**

| Construct | Focused supply chain integration (FC) | | | | | |
|---|---|---|---|---|---|---|
| Supply chain integration initiatives (SI) | Service functions are integrated (FC1) | | | Follow national procurement policies and procedures (FC2) | | |
| | $R^2 = 0.422$ | | | $R^2 = 0.015$ | | |
| | F = 20.781 | | sig (0.000)** | F = 0.447 | | sig (0.642) |
| Items | Standard β | t | (sig) significance | Standard β | t | sig. |
| Cross-functional process within the hospital (SI1) | 0.198 | 1.452 | 0.152 | 0.131 | 0.735 | 0.465 |
| • Integration with Customers (SI2) | 0.499** | 3.653 | 0.001 | - 0.010 | - 0.058 | 0.954 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SI1 = 0.544, SI2 = 0.544 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SI1 = 10.471, SI2 = 15.458 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 10.0: Hypothesis testing for Hlb**
**Regression results**

| Construct | Focused supply chain integration (FC) | | | | | |
|---|---|---|---|---|---|---|
| | Service functions are integrated (FC1) | | | Follow national procurement policies and procedures (FC2) | | |
| Organisation Strategy and SC1 drivers (ST) | $R^2$ = 0.354<br>F = 15.617 | | sig<br>(0.000)** | $R^2$ = 0.199<br>F = 7.059 | | sig<br>(0.002)** |
| Items | Standard β | t | (sig) significance | Standard β | t | sig. |
| • Organisation's corporate strategy includes SC1 (ST1) | 0.428** | 3.658 | 0.001 | 0.312** | 2.393 | 0.020 |
| • Centralised purchasing department (ST2) | 0.273 | 2.335 | 0.023 | 0.215 | 1.649 | 0.105 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: ST1 = 0.829, ST2 = 0.829 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: ST1 = 8.095, ST2 = 8.950 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 11.0: Hypothesis testing for Hlc**
**Regression results**

| Construct | Focused supply chain integration (FC) | | | | | |
|---|---|---|---|---|---|---|
| | Service functions are integrated (FC1) | | | Follow national procurement policies and procedures (FC2) | | |
| Performance improvement and SC1 (SP) | $R^2$ = 0.375<br>F = 11.193 | | sig<br>(0.000)** | $R^2$ = 0.106<br>F = 2.220 | | sig<br>(0.096) |
| Items | Standard β | t | (sig) significance | Standard β | t | sig. |
| • Ability to handle expected challenges (SP1) | 0.420** | 2.908 | 0.005 | 0.234 | 1.354 | 0.181 |
| • Lowering cost of Purchased items (SP2) | 0.287** | 1.935 | 0.058 | 0.181 | 1.023 | 0.311 |
| • Hospital prof-itability (SP3) | - 0.076 | - 0.617 | 0.540 | - 0.192 | - 1.303 | 0.198 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SP1 = 0.535, SP2 = 0.508, SP3 = 0.731 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SP1 = 10.711, SP2 = 12.980, SP3 = 18.792 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 12: Hypothesis testing for Hld**
**Regression results**

| Construct | Focused supply chain integration (FC) | | | | | |
|---|---|---|---|---|---|---|
| | Service functions are integrated (FC1) | | | Follow national procurement policies and procedures (FC2) | | |
| Organisation environmental forces (SE) | $R^2$ = 0.051<br>F = 1.533 | | sig<br>(0.225) | $R^2$ = 0.021<br>F = 0.597 | | sig<br>(0.554) |
| Items | Standard β | t | (sig.) significance | Standard β | t | sig. |
| • Suppliers have initiated integration effort (SE1) | - 0.160 | - 1.033 | 0.306 | - 0.020 | - 0.130 | 0.897 |
| • Customers have initiated integration efforts (SE2) | 0.271 | 1.749 | 0.086 | 0.153 | 0.976 | 0.333 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SE1 = 0.695, SE2 = 0.695 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SE1 = 8.022, SE2 = 8.792 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 13: Hypothesis testing for Hle**
**Regression results**

| Construct | Focused supply chain integration (FC) | | | | | |
|---|---|---|---|---|---|---|
| | Service functions are integrated (FC1) | | | Follow national procurement policies and procedures (FC2) | | |
| Barriers to Supply chain Integration (SB) | $R^2$ = 0.113<br>F = 2.373 | | sig<br>(0.080)* | $R^2$ = 0.153<br>F = 3.363 | | sig<br>(0.025)** |
| Items | Standard β | t | (sig.) significance | Standard β | t | sig. |
| • Lack of willingness to share information (SB1) | - 0.320* | - 1.751 | 0.085 | 0.058 | 0.327 | 0.745 |
| • Difficult to establish relationships based on shared risks and rewards (SB2) | 0.006 | 0.032 | 0.974 | - 0.373** | - 2.079 | 0.042 |
| • Inappropriate Information Systems (SB4) | - 0.082 | - 0.639 | 0.526 | - 0.158 | - 1.270 | 0.209 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SB1 = 0.476, SP2 = 0.471, SP3 = 0.973 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SB1 = 8.083, SB2 = 14.552, SB4 = 15.529 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 14.0: Hypothesis testing for Hlf**
**Regression results**

| Construct | Focused supply chain integration (FC) | | | | | |
|---|---|---|---|---|---|---|
| | Service functions are integrated (FC1) | | | Follow national procurement policies and procedures (FC2) | | |
| Supplier Commercial Relationships (SC) | $R^2$ = 0.244<br>F = 9.199 | | sig<br>(0.000)** | $R^2$ = 0.060<br>F = 1.827 | | sig<br>(0.170) |
| Items | Standard β | t | (sig.) significance | Standard β | t | sig. |
| • Reliable suppliers (SC1) | 0.164 | 1.185 | 0.241 | 0.204 | 1.320 | 0.192 |
| • Good process Integration between Suppliers, customers and the DHB (SC3) | 0.384** | 2.771 | 0.008 | 0.064 | 0.417 | 0.678 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SC1 = 0.692, SC3 = 0.692 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SC1 = 9.419, SC3 = 17.208 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 15.0: Hypothesis testing for H2a**
**Regression results**

| Construct | Supplier commercial relationships (SC) | | | | | |
|---|---|---|---|---|---|---|
| | Reliable suppliers (SC1) | | | Good process integration between suppliers, customers and the DHB (SC3) | | |
| Supply chain integration initiatives (SI) | $R^2$ = 0.065<br>F = 1.968 | | sig<br>(0.149) | $R^2$ = 0.231<br>F = 8.559 | | sig<br>(0.001)* |
| Items | Standard β | t | (sig.) significance | Standard β | t | sig. |
| • Cross-functional process within the hospital (SI1) | 0.221 | 1.272 | 0.209 | - 0.102 | - 0.645 | 0.521 |
| • Integration with Customers (SI2) | - 0.046 | 0.265 | 0.792 | 0.543* | 3.450 | 0.001 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SI1 = 0.544, SI2 = 0.544 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SI1 = 10.471, SI2 = 15.458 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 16.0: Hypothesis testing for H2b**
**Regression results**

| Construct | Supplier commercial relationships (SC) | | | | | |
|---|---|---|---|---|---|---|
| | Reliable suppliers (SC1) | | | Good process integration between suppliers, customers and the DHB (SC3) | | |
| Organisation strategy and SC1 drivers (ST) | $R^2$ = 0.289<br>F = 11.593 | | sig<br>(0.000)** | $R^2$ = 0.107<br>F = 3.408 | | sig<br>(0.040)* |
| Items | Standard β | t | (sig.) significance | Standard β | t | sig. |
| • Organisation's corporate strategy includes SC1 (ST1) | - 0.229 | -1.868 | 0.067 | 0.141 | 1.028 | 0.308 |
| • Centralised purchasing depar-tment (ST2) | 0.590** | 4.813 | 0.000 | 0.242* | 1.760 | 0.084 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: ST1 = 0.829, ST2 = 0.829 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: ST1 = 8.095, ST2 = 8.950 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 17.0: Hypothesis testing for H2c**
**Regression results**

| Construct | Supplier commercial relationships (SC) | | | | | |
|---|---|---|---|---|---|---|
| | Reliable Suppliers (SC1) | | | Good process integration between suppliers, customers and the DHB (SC3) | | |
| Performance improvement and SC1 (SP) | $R^2$ = 0.039<br>F = 0.748 | | sig<br>(0.528) | $R^2$ = 0.258<br>F = 6.495 | | sig<br>(0.001)** |
| Items | Standard β | t | (sig.) significance | Standard β | t | sig. |
| Ability to handle Expected challenges (SP1) | 0.063 | 0.353 | 0.726 | 0.033 | 0.210 | 0.835 |
| • Lowering cost of Purchased items (SP2) | 0.133 | 0.722 | 0.473 | 0.563** | 3.484 | 0.001 |
| • Hospital profit-Ability (SP3) | - 0.214 | - 1.399 | 0.167 | - 0.326 | - 2.420 | 0.019 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SP1 = 0.535, SP2 = 0.508, SP3 = 0.731 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SP1 = 10.711, SP2 = 12.980, SP3 = 18.792

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 18.0: Hypothesis testing for H2d**
**Regression results**

| Construct | Supplier commercial relationships (SC) | | | | | |
|---|---|---|---|---|---|---|
| | Reliable suppliers (SC1) | | | Good process integration between suppliers, customers and the DHB (SC3) | | |
| Organisation environmental forces (SE) | $R^2$ = 0.050<br>F = 1.494 | | sig<br>(0.233) | $R^2$ = 0.007<br>F = 0.213 | | sig<br>(0.809) |
| Items | Standard β | t | (sig.) significance | Standard β | t | sig. |
| • Suppliers have initiated integration effort (SE1) | - 0.213 | - 1.373 | 0.175 | - 0.050 | - 0.317 | 0.752 |
| • Customers have initiated integration efforts (SE2) | - 0.018 | - 0.118 | 0.906 | 0.103 | 0.650 | 0.518 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SE1 = 0.695, SE2 = 0.695 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SE1 = 8.022, SE2 = 8.792 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 19.0 : Hypothesis testing for H2e**
**Regression results**

| Construct | Supplier commercial relationships (SC) | | | | | |
|---|---|---|---|---|---|---|
| | Reliable Suppliers (SC1) | | | Good process integration between suppliers, customers and the DHB (SC3) | | |
| Barriers to SC1 (SB) | $R^2$ = 0.201<br>F = 4.692 | | sig (0.005)* | $R^2$ = 0.079<br>F = 1.593 | | sig (0.201) |
| Items | Standard β | t | (sig.) significance | Standard β | t | sig. |
| • Lack of willingness to share Information (SB1) | 0.379 | 2.185 | 0.033 | - 0.294 | - 1.581 | 0.119 |
| • Difficult to establish relationships based on shared risks and rewards (SB2) | - 0.472 | - 2.710 | 0.009 | 0.040 | 0.217 | 0.829 |
| • Inappropriate information system (SB4) | - 0.280* | - 2.315 | 0.024 | - 0.061 | - 0.471 | 0.639 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:

Tolerance: SB1 = 0.476, SB2 = 0.471, SB4 = 0.973 (> 0.20)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

Condition index: SB1 = 8.083, SB2 = 14.552, SB4 = 15.529 (< 30)

There is no significant multicollinearity effects
(Garson, 2008; Hair et al., 2006)

**Table 20.0: Hypothesis testing for H3a**
**Regression results**

| Construct | | Order fulfilment (OF) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Classify inventories according to their importance (OF1) | | | Collaborative planning, forecasting and replenishment (OF2) | | | An effort to control ordering costs (OF3) | |
| Supply chain integration initiatives (SI) | | $R^2 = 0.011$ F = 0.308 | sig (0.736) | | $R^2 = 0.126$ F = 4.127 | sig (0.021)** | | $R^2 = 0.009$ F = 0.248 | sig (0.781) |
| Items | Standard β | t | Significance (sig) | | Standard β | t | Sig | Standard β | t | Sig. |
| • Cross-functional process within the hospital (SI1) | 0.069 | 0.388 | 0.699 | | 0.243** | 1.447 | 0.153 | 0.085 | 0.477 | 0.635 |
| • Integration with Customers (SI2) | 0.043 | 0.241 | 0.810 | | 0.143 | 0.854 | 0.397 | 0.011 | 0.060 | 0.953 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:
Tolerance: SI1 = 0.544, SI2 = 0.544 (> 0.20) There is no significant multicollinearity effects (Garson, 2008); Hair et al, 2006)

Condition index: SI1 = 10.471, SI2 = 15.458 (< 30) There is no significant multicollinearity effects (Garson, 2008); Hair et al, 2006)

**Table 21.0: Hypothesis testing for H3b**
**Regression results**

| Construct | | Order fulfilment (OF) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Classify inventories according to their importance (OF1) | | | Collaborative planning, forecasting and replenishment (OF2) | | | An effort to control ordering costs (OF3) | | |
| Organisation Strategy and SC1 drivers (ST) | | $R^2 = 0.147$ F = 4.900 | sig (0.011)** | | $R^2 = 0.245$ F = 9.253 | sig (0.000)** | | $R^2 = 0.075$ F = 2.310 | sig (0.109) | |
| Items | Standard β | t | Significance (sig) | | Standard β | t | Sig | Standard β | t | Sig. |
| • Organisation's corporate strategy includes SC1 (ST1) | 0.296** | 2.201 | 0.032 | | 0.483** | 3.824 | 0.000 | 0.000 | 0.002 | 0.998 |
| • Centralised purchasing department (ST2) | 0.150* | 1.117 | 0.269 | | 0.027 | 0.214 | 0.831 | 0.274 | 1.956 | 0.055 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:
Tolerance: ST1 = 0.829, ST2 = 0.829 (> 0.20) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

Condition index: ST1 = 8.095, ST2 = 8.950 (< 30) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

**Table 22.0: Hypothesis testing for H3c**
**Regression results**

| Construct | | Order fulfilment (OF) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Classify inventories according to their importance (OF1) | | | Collaborative planning, forecasting and replenishment (OF2) | | | An effort to control ordering costs (OF3) | |
| Performance improvement and SC1 (SP) | | $R^2 = 0.115$ F = 2.427 | sig (0.075)** | | $R^2 = 0.072$ F = 1.451 | sig (0.238) | | $R^2 = 0.369$ F = 10.921 | sig (0.000) ** |
| Items | Standard ß | t | (sig) Significance | | Standard ß | t | Sig | Standard ß | t | Sig |
| • Ability to handle expected challenges (SP1) | 0.382** | 2.220 | 0.030 | | 0.170 | 0.965 | 0.339 | - 0.248 | - 1.708 | 0.093 |
| • Lowering cost of purchased items (SP2) | - 0.086 | - 0.486 | 0.629 | | 0.025 | 0.139 | 0.890 | 0.085 | 0.568 | 0.572 |
| • Hospital profitability (SP3) | 0.021 | 0.141 | 0.888 | | 0.123 | 0.817 | 0.417 | 0.647** | 5.213 | 0.000 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:
Tolerance: SP1 = 0.535, SP2 = 0.508
SP 3 = 0.731 (> 0.20) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

Condition index: SP1 = 10.711, SP2 = 12.980
SP3 = 18.792 (< 30) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

**Table 23.0: Hypothesis testing for H3d**
**Regression results**

| Construct | | Order fulfilment (OF) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Classify inventories according to their importance (OF1) | | Collaborative planning, forecasting and replenishment (OF2) | | | An effort to control ordering costs (OF3) | | |
| Organisation environmental forces (SE) | | $R^2 = 0.021$<br>F = 0.599 | sig<br>(0.553) | $R^2 = 0.137$<br>F = 4.515 | sig<br>(0.015)** | | $R^2 = 0.029$<br>F = 0.853 | sig<br>(0.432) | |
| Items | Standard ß | t | (sig)<br>Significance | Standard ß | t | Sig | Standard ß | t | Sig |
| • Suppliers have initiated integration effort (SE1) | 0.171 | 1.086 | 0.282 | 0.045 | 0.304 | 0.762 | 0.075 | 0.479 | 0.634 |
| • Customers have Initiated integration efforts (SP2) | - 0.112 | 0.714 | 0.478 | 0.343** | 2.325 | 0.024 | 0.117 | 0.749 | 0.457 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:
Tolerance: SE1 = 0.695, SE2 = 0.695 (> 0.20) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

Condition index: SE1 = 8.022, SE2 = 8.792 (< 30) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

**Table 24.0: Hypothesis testing for H3e**
**Regression results**

| Construct | Order fulfilment (OF) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Classify inventories according to their importance (OF1) | | | Collaborative planning, forecasting and replenishment (OF2) | | | An effort to control ordering costs (OF3) | | |
| Barriers to SC1 (SB) | $R^2$ = 0.359<br>F = 10.432 | | sig<br>(0.000)** | $R^2$ = 0.033<br>F = 0.646 | | sig<br>(0.589) | $R^2$ = 0.299<br>F = 7.977 | | sig<br>(0.000) ** |
| Items | Standard ß | t | (sig) Significance | Standard ß | t | Sig | Standard ß | t | Sig |
| • Lack of willingness to share information (SB1) | 0.704 | 4.534 | 0.000 | 0.149 | 0.784 | 0.437 | 0.516** | 3.182 | 0.002 |
| • Difficult to establish relationships based on shared risks and rewards (SB2) | - 0.861** | - 5.524 | 0.000 | - 0.047 | - 0.243 | 0.809 | - 0.034 | - 0.191 | 0.849 |
| • Inappropriate inform-ation systems(SB4) | 0.010 | 0.093 | 0.926 | - 0.151 | - 1.132 | 0.262 | - 0.362* | - 3.190 | 0.002 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:
Tolerance: SB1 = 0.476, SB2 = 0.471
SB4 = .973 (> 0.20) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

Condition index: SB1 = 8.083, SB2 = 14.552
SB4 = 15.529 (< 30) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

**Table 25: Hypothesis testing for H3f**
**Regression results**

| Construct | | Order fulfilment (OF) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Classify inventories according to their importance (OF1) | | | Collaborative planning, forecasting and replenishment (OF2) | | | An effort to control ordering costs (OF3) | |
| Supplier commercial relationships (SC) | | $R^2 = 0.083$ | | | $R^2 = 0.222$ | | | $R^2 = 0.109$ | |
| | | F = 2.581 | sig (0.085) | | F = 8.140 | sig (0.001)** | | F = 3.497 | sig (0.037) * |
| Items | Standard ß | t | (sig) Significance | | Standard ß | t | Sig | Standard ß | t | Sig |
| • Reliable suppliers (SC1) | 0.281 | 1.844 | 0.070 | | 0.302** | 2.149 | 0.036 | 0.372 | 2.477 | 0.016 |
| • Good process integ-gration between suppliers, customers and the DHB (SC3) | 0.012 | 0.081 | 0.936 | | 0.231** | 1.647 | 0.105 | - 0.322* | - 2.146 | 0.036 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:
Tolerance: SC1 = 0.692, SC3 = 0.692 (> 0.20) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

Condition index: SC1 = 9.419, SC3 = 17.208 (< 30) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

**Table 26.0: Hypothesis testing for H3g**
**Regression results**

| Construct | | Order fulfilment (OF) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Classify inventories according to their importance (OF1) | | | Collaborative planning, forecasting and replenishment (OF2) | | | An effort to control ordering costs (OF3) | |
| Focused SC1 (FC) | | $R^2 = 0.088$ | | | $R^2 = 0.164$ | | | $R^2 = 0.065$ | |
| | | F = 2.742 | sig (0.073) | | F = 5.597 | sig (0.006)** | | F = 1.988 | sig (0.146) |
| Items | Standard ß | t | (sig) Significance | | Standard ß | t | Sig | Standard ß | t | Sig |
| • Service functions are integrated (FC1) | 0.213 | 1.506 | 0.138 | | 0.452** | 3.345 | 0.001 | 0.235 | 1.640 | 0.107 |
| • Follow national procurement policies and procedures (FC2) | 0.132 | 0.935 | 0.354 | | - 0.196 | - 1.448 | 0.153 | 0.041 | 0.286 | 0.776 |

** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

Test for potential multicollinearity effects:
Tolerance: FC1 = 0.802, FC2 = 0.802 (> 0.20) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006)

Condition index: FC1 = 8.404, FC2 = 10.125 (< 30) There is no significant multicollinearity effects (Garson, 2008; Hair et al, 2006).