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

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LIST OF ABBREVIATIONS

SPSS - Statistical Package for Social Sciences

DHB - District Health Boards

SCI - Supply chain integration

GSCF - The Global Supply Chain Forum

SCOR - Supply Chain Operations Reference

ATTESTATION OF AUTHORSHIP

"I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent that has been submitted for the award of any other degree or diploma of a university or other institution of higher learning."

Kabossa A.B. Msimangira
May 2010

CONFERENCE PAPERS

- Msimangira, K.A.B. (2010). Supply chain integration operational issues: impact on supplier relationships and order fulfilment in New Zealand public hospitals. Conference Proceedings (CD ROM) of the 21st *Annual Production and Operations Management Society conference* held in Vancouver, Canada, 7 – 10 May, 2010.

- Msimangira, K.A.B. (2009). Supply chain integration, supplier relationships, and order fulfilment practices in public hospitals. *Conference Proceedings (CD ROM) of* the 20th *Annual Production and Operations Management Society conference* held in Orlando, Florida, U.S.A, 1 – 4 May, 2009.

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ABSTRACT

Although there is general understanding on the importance of supply chain integration (SCI), little is known regarding SCI operational issues and their impact on supplier commercial relationships and order fulfilment in public hospitals. In response, this thesis investigates the critical operational factors influencing the supply chain integration and their impact on supplier commercial relationships and order fulfilment in New Zealand public hospitals. This study explores critical SCI issues using the process-based management theory (approach) proposed by Lambert (2004, 2008). A new construct of focused SCI and a theoretical model have been developed for this study.

A survey research approach was used to collect data. The results of empirical study are based on the responses from a survey with purchasing and supply personnel in public hospitals. This research tested eighteen hypotheses using multiple regression analysis. The results of this thesis support sixteen hypotheses proposed in the theoretical model and two hypotheses are not supported. The major findings of this research are that SCI operational issues in the hospitals, supplier commercial relationships, and focused SCI have positive influence on order fulfilment. Barriers to SCI (one of the operational issues) have negative influence on supplier commercial relationships, focused SCI, and order fulfilment. The results for two hypotheses not supported in this thesis show that organisation environmental forces (suppliers or customers have initiated integration effort) do not have significant influence on focused SCI (integrated service functions, following national procurement policies and procedures). Also, organisation environmental forces do not have significant influence on supplier commercial relationships (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, Magnan, and McCarter (2008). However, Fawcett and Magnan (2001) and

Fawcett et al. (2008) found inappropriate information systems as the key barrier to effective SCI, whereas, this research identified lack of willingness to share information as the key barrier to effective SCI in the public hospitals.

Overall, this research provides significant contributions to the SCI, supplier commercial relationships, and order fulfilment literature and the practices of SCI in New Zealand public hospitals. This research also contributes to theoretical and practical knowledge by providing a new model for enhancing SCI in an organisation. The model can help researchers and managers to focus on important SCI, supplier commercial relationships, and order fulfilment factors. The critical SCI operational factors linkage to supplier commercial relationships, focused SCI, and order fulfilment have been tested for the first time.

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

CHAPTER 1.0 INTRODUCTION

(See also Msimangira (2009, May 1-4) for sections 1.1 – 1.7)

1.1 Background to the study

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 (Basu & Wright, 2008).

Lambert, Cooper, and Pagh, (1998a, 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 being: 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, et al., 1998a). 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 et al. (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. (1998a) 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. Recent SCM literature has emphasized the importance of SCI in creating value and reducing costs (Lee, 2000; Lee & Wolfe, 2000, 2003) and the cost of logistics in the supply chain (Delaney, 2000).

There are many definitions of SCM/SCI in the literature (see section 2.2.1). In order to minimise misunderstanding of the SCI theory, it was important to provide the respondents with a definition of SCI used in this research. The definition of SCI (see survey questionnaires in appendices B and D) by the National Research Council (2000) was adopted for this research because it is widely accepted by the academics and practitioners.

1.2 Rationale of the study

Studies of SCM/SCI issues in the health sector are scarce in the literature, but include e.g.,Task Force Report on Supply Chain Management, a joint initiative of the Ontario Hospital Association of Canada (November, 2001) 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.

Furthermore, in the context of NZ there is little research on SCI in general (Campbell, 2002; Campbell & Sankaran, 2005). The work that has been published does not address the SCI factors and their impact on supplier commercial relationships and order fulfilment are not addressed.

1.3 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, and to lower operational costs, especially the cost of procurement in the public hospitals and other health service providers (Dew and Davis, 2005). 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 (Appendix A) (Ministry of Health in New Zealand).

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.

An initial investigation on supply chain in public hospitals reveals three types of supply chain networks (Figure 1.1):

(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);

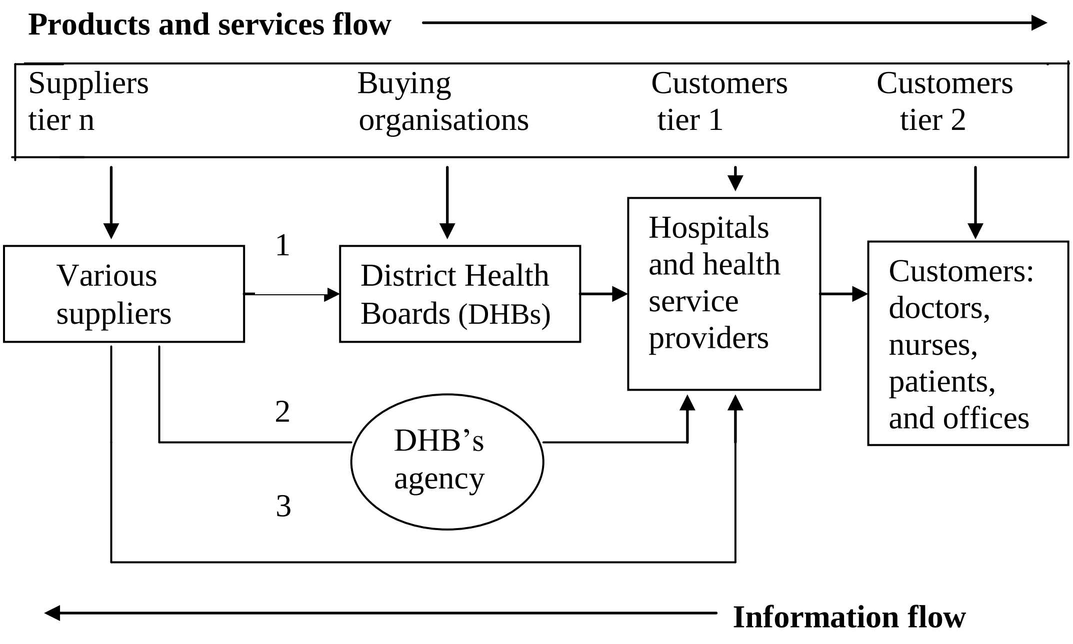
(2) DHB’s Agency buys products and services from various suppliers in order to meet the requirements of the customers tier 1; and

(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, personal communication, September 13, 2006).

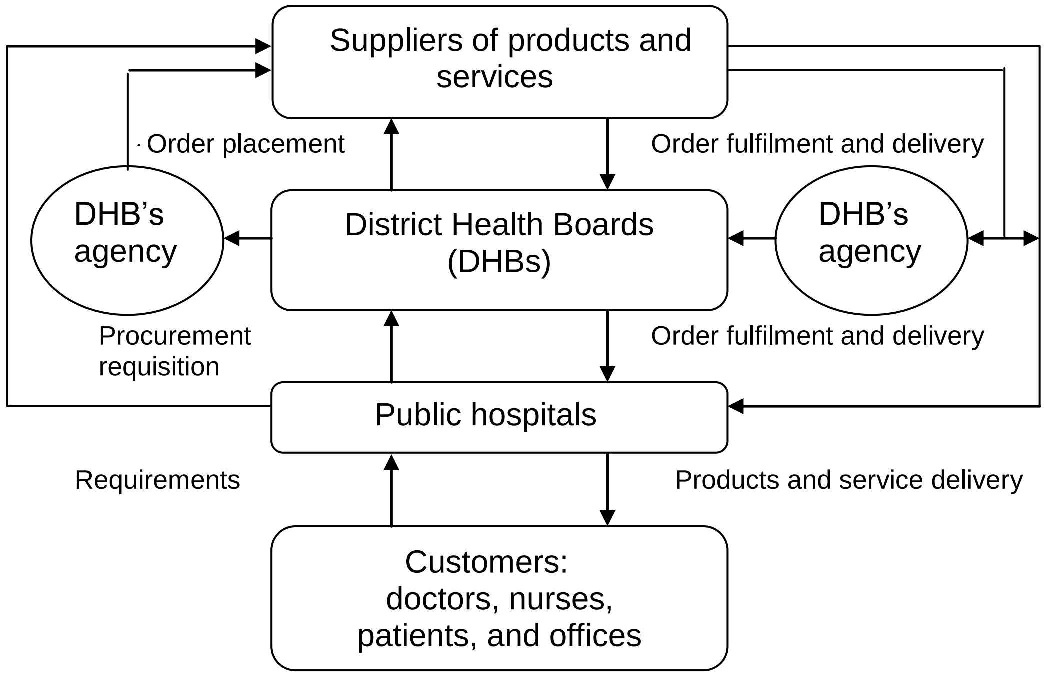
After reviewing the existing SC in NZ public health sector, I, Dew and Davis (2005) found that SC is not standardised, and hospitals have different ways of meeting their procurement needs. Hospitals get their requirements through an agency or direct from the suppliers.

Figure 1.1: Products and services supply chain network in public health sector in New Zealand



Source: Author

Figure 1.2: Model of the supply chain for products and services in the public health sector of New Zealand



Source: Author

In summary, the literature on critical factors influencing SCI is limited for the health care sector, and does not focus on the impact on supplier commercial relationships and order fulfilment. This study attempts to fill that gap by conducting an empirical study which examines the critical factors influencing supply chain integration in the NZ public hospital sector.

1.4 Research problem

Most frameworks in the literature are not suitable for all organisations. The research problem under investigation is:

What are potential critical operational factors that can influence the supply chain integration and their impact on supplier commercial relationships and order fulfilment in the NZ public hospital sector?

In general, this research is intended to identify critical factors which have impact on the implementation of SCI, supplier commercial relationships, and order fulfilment. There is lack of a model or framework for SCI in the public hospital sector, in particular one which considers critical constructs on supplier commercial relationships and order fulfilment. Lambert et al. (1998a, p.14) in their study on SCM revealed that one of the areas for future research is "what are critical factors to the firms success and that enable the firm to link with specific companies? Also, " What are the barriers to forming these relationships?" In addition, Lambert et al. (1998a, p. 14) emphasized that " a top priority should be research to develop a normative model that can guide managers in the effort to develop and manage their supply chains." This study aims to fill this gap by developing a model which will help the public hospitals to improve performance in order fulfilment.

1.5 Objectives of the study

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 (see Figure 3.1): 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).

This thesis aims to investigate supply chain integration factors, supplier commercial relationships,and order fulfilment practices, which have received little attention in the literature, especially regarding the NZ public hospitals.

The link between supply chain integration factors, supplier commercial relationships, and order fulfilment, with reference to the NZ public hospitals is a gap in the literature that requires investigation.

The research stresses the factors that are likely to affect SCI in public sector hospitals and other health service providers. In general, the research seeks to:

(a) Identify and examine the critical operational factors that are likely to affect the supply chain integration and their impact on supplier commercial relationships and order fulfilment in the NZ public hospital sector

(b) Develop a framework that determines necessary / required level of supply chain integration in NZ public hospital sector

(c) Develop a model assessment and test of hypotheses for supply chain integration in the public hospital sector to achieve the order fulfilment goals and improve supplier commercial relationships.

Unlike earlier research work in NZ on the SCI in two SMEs (Campbell & Sankaran, 2005) in which the authors did not identify critical factors and test the measurement items of the SCI enhancement framework, this study aims to examine in-depth SCI in the public hospital sector in NZ, to identify existing problems in enhancing SCI, and to provide a framework to solve existing SCI problems in the public hospitals.

1.6 Key research questions

The purpose of this study is to consider supply chain integration in the public hospitals:

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?

1.7 Significance of the study

Summary

It is evident that SCI has been considered as a means to reduce operations costs and supply chain ineficiencies, and improve the service level in an organisation. Lack of integration between members of a supply chain results in operational inefficiencies and hinders the performance of the supply chain (Lambert, 2004). Early SCI research has focused mostly on the management process integration issues related to the manufacturing sector and part of the service sector. Little is known concerning how public hospitals attain SCI. It is thus evident that there are still gaps in SCI knowledge in determining the factors which influence order fulfilment in public hospitals. A review of the literature indicates that SCI influences and their impact on supplier commercial relationships and order fulfilment in public hospitals are not known.

This research seeks to identify critical factors or operational issues that affect SCI in the New Zealand public hospitals. The SCI influences and their impact on supplier commercial relationships and order fulfilment will be examined critically.

1.8 Summary of contributions

1.8.1 Expected managerial contributions

This research will contribute to the existing literature in the following areas:

First, there is a need to identify factors critical to the firm's success that enable the firm to link with specific companies (Lambert, et al., 1998a). This research will assist in this by examining critical factors in supply chain integration, supplier commercial relationships, and order fulfilment in the NZ public hospitals.

Second, this research will develop a model for SCI which integrates existing theory, and explains the critical factors influencing SCI and their impact on supplier commercial relationships and order fulfilment in the public hospitals. This model will provide a framework in which the relationships between critical factors in SCI, supplier commercial relationships, and order fulfilment can each be tested separately using empirical data from public hospitals in NZ.

Therefore, the overall research contribution to enhancing supply chain integration in the public hospital sector in NZ will be the following:

(a) The identification of the critical operational factors influencing supply chain integration in the hospitals.

(b) The determination of influences to enhance the level of supply chain integration in the hospitals.

(c) The identification of major factors that improve the service levels in terms of order fulfilment, and reduced supply chain operational costs.

(d) The identification of key factors that improve the effectiveness of supplier commercial relationships.

1.8.2 Management implications

Research implications for supply chain integration

The findings of this study will 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 will be conducted in the public hospital sector, it will also have implications for the private hospital sector. In addition, this study will enhance the current process-based theory by adding other critical factors required to be addressed to improve SCI for an organisation.

1.9 Outline of the thesis

This thesis is organised into six chapters. The current chapter, chapter 1, introduces the background to the study, supply chain in the public hospital sector in New Zealand, research problem, research questions, rationale and significance of the study, and expected managerial and theoretical contributions. The second chapter reviews the literature on SCM, SCI, supplier commercial relationships, order fulfilment, and health care supply chain integration. The third chapter presents the model development, which includes the theoretical model, developed hypotheses, and development of the measures. The fourth chapter discusses the research design and methodology. The fifth chapter presents data analysis and results. Finally, the sixth chapter presents discussion of results and conclusion, including the theoretical and managerial implications of this research, study limitations, and future research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of the literature with respect to theoretical perspectives (supply chain management theories, process-based management theory), SCM, SCI (internal and external), health care SCI, supplier commercial relationships, order fulfilment, and SCI studies in New Zealand. This study conceptualizes SCI as the integration of some of the business processes, such as supplier relationships and customer order fulfilment, which have received less attention in the literature regarding the public health sector. The chapter concludes with a discussion of gaps and a set of research questions developed after the review of the research literature. Past research relevant to this thesis is summarised in Tables 2.2 to 2.9.

2.2 Theoretical perspective

2.2.1 Supply chain management theories

The literature on supply chain management is based on various theories and models, which make it difficult to determine the best theory or model suitable for study of SCM and implementation. Although the field of SCM has been growing fast, there is still a lack of academic literature regarding methodologies to guide and support SCM evaluation and implementation (Akkermans, Bogerd, & Doremalen, 2004; Croxton, Garcia-Dastugue, Lambert, Rogers, 2001; Lambert et al. 1998a). The literature on SCM inclines to change between description, prescription and trend identification (Storey, Emberson, Godsell, & Harrison, 2006).

The study on SCM theory, practice and future challenges conducted by Storey et al. (2006, p. 754) revealed that “supply chain management is, at best, still emergent in terms of both theory and practice. Few practitioners were able – or even seriously aspired – to extend their reach across the supply chain in the manner prescribed in much modern theory.” Many researchers (e.g., Skjoett-Larsen, 1999; Madhok, 2002) use different theories to SCM and still there are some differences in accepting a single theory in the literature to solve SCM problems. Skjoett-Larsen (1999) and Madhok (2002) discuss SCM theories, such as the principal-agent theory, transaction cost analysis, the network perspective, and the resource-based view. Lambert, Garcia-Dastugue, and Croxton (2005) identify the following five SCM frameworks that emphasise the requirement to implement business processes across firms:

(1) The Global Supply Chain Forum (GSCF) framework. The GSCF defines SCM as "the integration of key business processes from end user through original suppliers that provide products, services, and information that add value for customers and other stakeholders" (Lambert et al., 1998a, p. 1). The eight SCM processes are discussed in section 2.3.4;

(2) Supply-Chain Operations References (SCOR) framework (Supply Chain Council, 2003). The framework is composed of five business processes discussed in section 2.4.

(3) The framework with three business processes: customer relationship management, product development management, and supply chain management (Srivastava, Shervani, & Farey, 1999);

(4) The framework based on three areas: operational, planning and control, and behavioural (Bowersox, Closs, & Stank, 1999). The framework was extended (Melnyk, Stank, & Closs, 2000) to include eight business processes: plan, acquire, make, deliver, product design/redesign, capacity management, process design/redesign, and measurement;

(5) Mentzer, 2004; Mentzer, 2001; and Mentzer et al. (2001) developed SCM framework that focuses on cross-functional interaction in an organisation and the relationships with supply chain members.

Lambert et al. (2005, p. 30) argue that "only the GSCF and SCOR frameworks include business processes that could be used by management to achieve cross-functional integration and are described in the literature with enough detail to draw meaningful comparisons." Managers can select the best framework that meets their organisation's supply chain. The comparison of SCM frameworks is indicated in Table 4.0.

Table 2.1: Summary of comparison of supply chain management frameworks

Criteria	**GSCF**	**SCOR**
Scope: strategic driver	Corporate and functional strategies	Operations strategy
Scope: breadth of activities	All activities related to the successful implementation of the eight business processes (see section 2.2.4)	All transactional activities related to demand-supply planning, sourcing, production, distribution and reverse logistics
Intra-company connectedness	Organisation-wide cross-functional integration	Cross-functional interaction and information sharing
Inter-company connectedness	Relationship management	Transactional efficiency
Drivers of value generation	Economic value added	Cost reduction and asset utilisation

Source: Lambert et al. (2005, p. 37).

The management theories, especially the process-based management theory provides theoretical guidance for this research because it deals with critical business processes in an organisation. The process management theory assists to explain the nature of SCI, as claimed by Lambert (2004, 2008).

2.2.2 Process – based management theory

The process management theory is one of the theories (such as resource-based theory, SCOR model, etc.), which helps to describe the nature of SCI. Lambert et al. (1998a, p. 1) and Lambert (2004, 2008, p. 3) define SCM as "the integration of business processes from end user through original suppliers that provide products, services, and information that add value for customers" (see section 2.3.4).

The use of the process - based management theory in addressing SCI operational issues, such as: supply chain initiatives, performance improvement, organisation environmental forces, barriers to SCI highlighted by Fawcett and Magnan (2001), and organisation strategy, and their impact on supplier commercial relationships and order fulfilment, is less known. Hammer (2001, p. 82) states that "although the concept of supply chain integration has been around for some time now, companies have had trouble making it reality. In most cases, that's because they've viewed it as merely a technological challenge rather than as what it really is: a process and management challenge." There is a need for further study to enhance the process-based theory because previous studies on SCI did not consider operational issues, such as supply chain initiatives, performance improvement, environment forces, and barriers to SCI highlighted by Fawcett and Magnan (2001) and their impact on commercial supplier relationships and order fulfilment, and also their effect on the focused SCI.

Many researchers recognize the SCI as a process-based initiative (e.g., Christopher, 1992; Porter, 1997; Van Hoek, 1998 (a) & (b); Lambert, et al., 1998; Lambert, 2004, 2008; Akkermans, et al., 1999). However, the researchers have differences in the areas of emphasis regarding SCM and SCI initiatives.

This research considered two out of eight key SCM processes identified by Lambert (2008): supplier relationship management and order fulfilment. These processes were selected by the purchasing and supply executives in the NZ public hospitals, as key issues for investigation.

2.3 Supply chain management

2.3.1 Definitions

There have been many definitions and variations of the term SCM in the literature, and some definitions include SCI. For example, Cooper and Ellram (1993, p.13) define SCM as “an integrative philosophy to manage the total flow of a distribution channel from the supplier to the ultimate user.” Bowersox, Closs, and Stank (1999, p. 1) state that the supply chain management mission is “to manage the efficient and effective sourcing, production, and delivery of products, services, and related information, from point of material origin to point of ultimate consumption, to maximize value for the end-customer.”

The definition provided by Morey (1997) emphasises on specific management functions. Morey defines supply chain management as “the process of planning, organizing, and controlling the flow of materials and services from suppliers to end users/ customers. This integrated approach incorporates suppliers, supply management, integrated logistics, and operations” (Bloomberg, LeMay, & Hanna, 2002, p. 1).

The competition in a global market has forced companies (organisations) to focus on supply chains where the inter-network competition is based. Mentzer et al. (2001) define supply chain as a set of companies involved in the upstream and downstream flows of products, services, finances, and information from a source to a customer.

Supply chain is a complex network of organisations covering both on the upstream side including tiers of suppliers and on the downstream side including a network of customer companies, retailers and financial consumers (Desouza, Chattaraj, & Kraft, 2003). Dershin (2000) claims that the supply chain is the “mother of all processes” because of the nature of its size, scope, and complexity, nearly all the processes in the supply chain are not under control. In addition, Msimangira (2003) emphasise that the purchasing and supply chain function is strategic, and supply chain executives need training in SCM processes. Tracey

> and Smith-Doerflein (2001) also stress the need for trainers to assist in the development of individuals in the area of supply chain management. The findings from the study by Gowen III and Tallon (2003, p. 32) propose "an interactive role of managerial and employee support to enhance the effectiveness of employee support to training and to mitigate the adverse effect of implementation barriers on the success of SCM practices."
>
> In order for an organisation/business to be successful in the competitive environment, there is a need to integrate an organisation's network of a commercial relationships. Competition is no longer among separate businesses, but among groups of firms that are linked together in a chain for delivering customer value (Chandra, 2000). (Msimangira & Tesha, 2009, pp. 7-8.)

Supply chain management is a strategy which can help an organisation achieve integration (Sadeh, Smith, & Swaminathan, 2003; Christopher & Ryals, 1999). The Global Supply Chain Forum (GSCF) based in the College of Business at The Ohio State University (U.S.A) defines SCM as "the integration of key business processes from end user through original suppliers that provide products, services, and infromation that add value for customers and other stakeholders" (Lambert, 2004; Chan & Qi, 2003). Lambert, et al. (1998a, p.1) define the SCM concept as "integration of business processes from end user through original suppliers that provides products, services, and infromation that add value for customers." Cox (2004) argues that SCM is a proactive relationship between a buyer and supplier, and the integration is across the entire SC. According to Handfield and Nichols, (2002, p. 8), SCM is "the integration and management of supply chain organisations 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." Basu and Wright (2008) go further and include the transfer of funds in some supply chains.

Although most researchers and practitioners agree that there are many definitions and variations of SCM, the two leading SCM professional bodies in the world: CIPS and ISM, both emphasise on ‘supply chain integration’ in their definitions:

> The Chartered Institute of Purchasing and Supply, CIPS (U.K.) defines SCM as “the selection and linking of suppliers and customers through negotiation and agreement to achieve customer satisfaction by providing value added products and services within beneficial and profitable relationships of all parties within the supply chain.” And “supply chain management is the continuous planning, developing, controlling, informing and monitoring of actions within and between supply chain links so that an integrated supply process results which meets overall strategic goals” (CIPS, 2007).
>
> The Institute for Supply Management, ISM (U.S.A) defines SCM as “the design and management of seamless, value-added processes across organizational boundaries to meet the real needs of the end customer. The development and integration of people and technological resources are critical to successful supply chain integration” (ISM, 2007).

SCM has received a great deal of attention over the past decade as a means for increasing national wealth and corporate competitiveness. Studies conducted in the United States (U.S.) reveal that the costs of logistics services, including transportation, inventory holding as well as related administrative charges account for 10-13 percent of gross domestic product (GDP) in most developed countries and regions around the world (Delaney,1999).

2.3.2 Benefits of SCM

There are many good examples of companies (e.g. Toyota) in the literature that have benefited from SCM. Companies such as Dell, General Electric, Cisco, and Ford have reported significant benefits (Lee & Whang, 1999). At the level of individual companies overseas, very impressive gains in market share (e.g., Dell Computers (Magretta, 1998)) and/ or reduction in operating costs (Wal-Mart) have been achieved by implementing the concepts of the SCM. Dell's direct sales to customers and the internet commerce have helped the company to increase the market share. Wal-Mart's goods are dispatched to the stores without maintaining inventory, thus reducing the cost of sales (Simchi-Levi, Kaminsky, & Simchi-Levi, 2003, p. 7).

Storey, Emberson, Godsell, and Harrison (2006) identified three core enablers and inhibitors of SCM: transparency of information and knowledge; supply chain behaviour; and performance measurement. Furthermore, they found that the factors "can either serve to enable or inhibit supply chain management depending on the context and the way in which the factor is utilized" (Storey, et al., p. 766).

2.3.3 Problems of SCM

Although there are many benefits of SCM reported in the literature, most SCM linked problems originate from either uncertainties or an inability to co-ordinate activities and partners (Turban, McLean, & Wetherbe, 2004). The bullwhip effect (demand variability) is one of the most common problems in suply chains discussed in the literature (Fransoo & Wouters, 2000; Basu & Wright, 2008). Small fluctuations in demand or inventory levels of the final company/organisation in the chain are reflected throughout the chain. Every company/organisation in the SC has limited or incomplete information regarding the needs of other members in the SC, and it has to respond with a disproportional increase in inventory levels and subsequently an even larger fluctuation in its demand relative to others in the chain (Forrester, 1961).

Researchers (e.g., Forrester, 1961; Holweg & Bicheno, 2002) have indicated that the production peak can be significantly decreased by the flow of information directly from the customer to the manufacturer. The other problem in the SC is that some companies/organisations optimise their own performance without taking into consideration the benefits of the whole SC. The maximum efficiency of each component of a chain does not accordingly lead to global optimisation (Gunasekaran, Patel, & McGaughey, 2004).

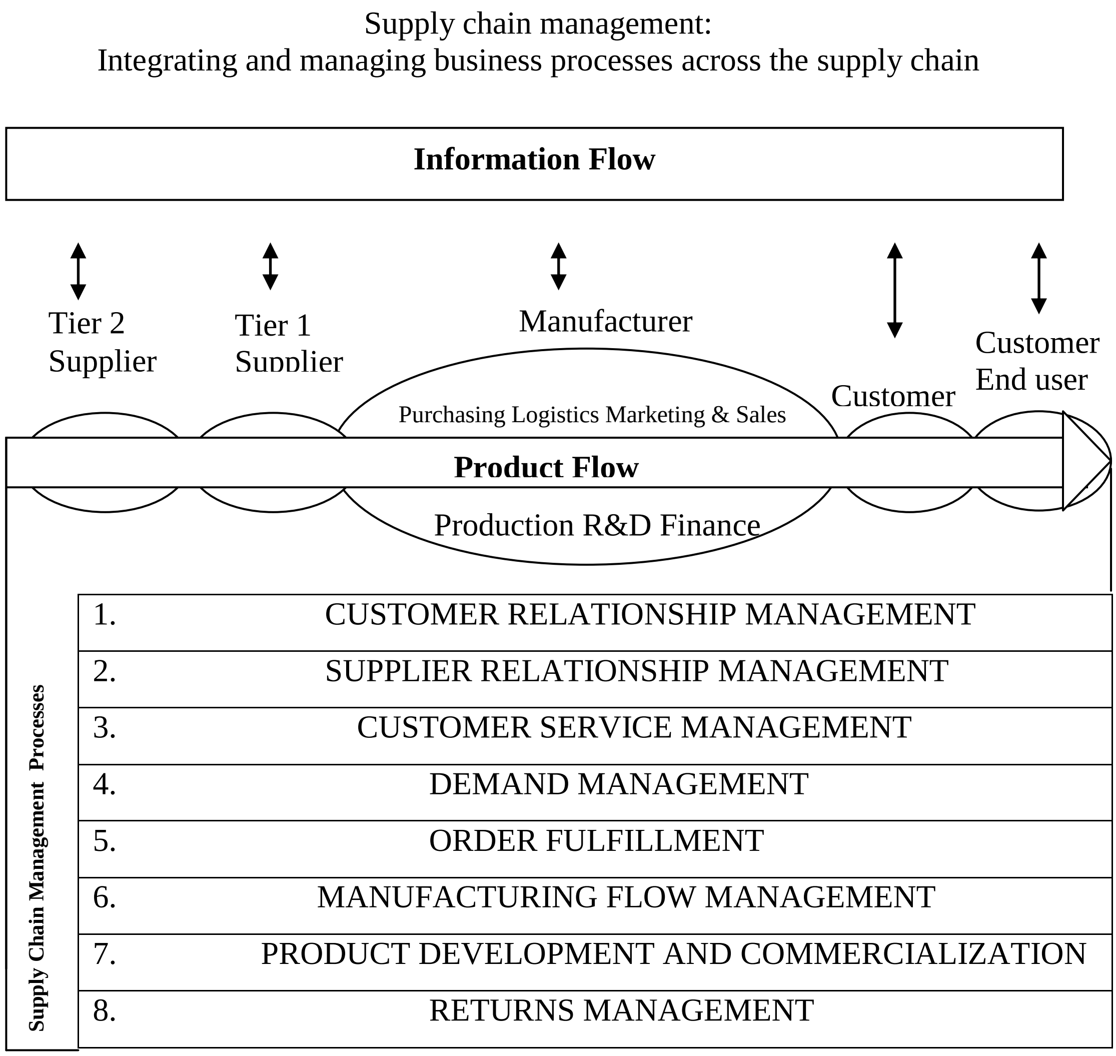
(See also Msimangira (2009, May 1- 4) for sections 2.3.4-2.4, 2.5.1-2.5.5, 2.6, 2.6.1-2.6.5, 2.7.1-2.7.2, 2.8, 2.9.1-2.9.4, 2.10)

2.3.4 Integration

Lambert (2004) emphasises that successful supply chain management needs cross-functional integration of key business processes within the firm and across the network of companies that consist of the supply chain. Furthermore, Lambert (2004) states that executives in many companies struggle to accomplish the required integration because they don't fully understand the supply chain business processes and the linkages required to integrate eight key SCM processes (Figure 2.1) identified by members of The Global Supply Chain Forum:

- Customer relationship management
- Customer service management
- Demand management
- Order fulfilment
- Manufacturing flow management
- Supplier relationship management
- Product development and commercialization
- Returns management (Lambert, 2004).

Figure 2.1: Eight key supply chain management processes



Source: Adapted from Lambert (2008, p. 3). Supply chain management: processes, partnerships, performance. Sarasota, Florida: Supply Chain Management Institute.

2.4 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 & 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 & Cooper, 2000; Morrell & Ezingeard, 2002). 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, and 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 order to achieve an effective integration, there is a need for SCI to contribute more than reduce costs (Lee, 2000). 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.

2.4.1 Semi-integration

Some authors do not agree that integration and close collaboration is suitable in every case because of "difficulty of collaboration" (Fawcett & Magnan, 2002, p. 360). Bask and Juga (2001) argue that there is a need to re-examine the leading view of integrated SCM. They suggest a change from holistic integration towards semi-integrated supply chains because SCI "involves various dimensions and varying intensities" (Bask & Juga, 2001, p. 149). As a result, the level of integration in some companies will differ from that in other companies. Sundaram and Mehta (2002) do not support Bask and Juga's (2001) argument that the emphasis should be on semi-integration. Sundaram and Mehta (2002, p. 548) conducted a comparative study of three SCM approaches: (1) independent approach, (2) semi-integrated approach, and (3) integrated approach. Their study concluded that the integrated supply chain approach resulted in "a plan with the least cost along the supply chain" as compared to the semi-integrated supply chain and independent approaches.

The results supported their “contention of better supply chain performance with increased collaboration across the supply chain.” A sample study by Power (2005, p. 252) of the literature relating to the integration and implementation of SCM practices revealed that “an important emergent theme from the literature is the importance of taking a holistic view and systemic nature of interactions between the participants” in the supply chain.

Ho and Chi (2005) state that applying e-commerce solutions to the SC can increase the efficiency of coordination and resource integration among partners, and emphasize that there is a need to monitor and assess supply-chain performance to ensure the objective of supply chain integration is met. Shen (2005) adds that globalization and information technologies require companies to integrate themselves into the supply network, align their business strategy with the SC operation, leverage information technology (IT) with process improvement, and initiate operational innovation for better firm performance. Van Donk and Van der Vaart (2005) argue that uncertainty of business conditions enhances the need for more integration, while shared resources (including IT) limit the chances of reaching a high level of integration.

2.4.2 Internal and external supply chain integration

There is a need for an organisation to consider both internal and external integration (Daugherty, Ellinger, & Gustin, 1996). Bowersox and Closs (1996, p. 488) emphasise this by stating that “ to succeed in the long run a firm must be able to achieve sufficient internal and external integration to satisfy fundamental business objectives.” Nevertheless, many authors in the literature suggest that it is important to concentrate on integrating the internal supply chain before an organisation tries to integrate with its business partners or external integration (e.g., Stevens, 1989; Byrne & Markham, 1991; Hewitt, 1994; Burnell, 1999; Stock & Lambert, 2001) and the study of logistics and supply chain practices of Australian and NZ firms by Mollenkopf and Dapiran (2005) reveals that the majority of the firms still focus their efforts on internal logistics integration issues. A study conducted by Pagell (2004) on the drivers of internal integration revealed that internal integration is a complex issue driven by a number of factors, including the structure and culture at the plant, reward systems, and the amount of formal and informal communication across the functions. Irrespective of these concerns, however, Narasimhan and Kim (2002) stress the need for a system-wide integrated network as an important determinant of SC performance. It follows that both internal and external functions must be integrated. However, Barratt (n.d.) argues that lack of visibility across the supply chain together with adversarial relationships among members are key barriers to SCI, and stresses the use of collaborative planning to solve these barriers.

2.4.3 Internal supply chain integration

Internal supply chain integration is defined as the degree of coordination between the internal functions of all the trading partners in the supply chain (Stevens, 1989; Carter & Narasimhan, 1996; Narasimhan & Carter, 1998; Birou, Fawcett, & Magnan, 1998; Wisner & Stanley,1999). However, “the effort required to identify key functional activities and their interrelationships has caused many companies to change from integrating and managing supply chains by functions to integrating and managing them by process (process management)” (National Research Council, 2000, p. 36).

Stevens(1989) discusses internal integration as a comprehensive integrated planning and control system that manages the flow of goods into and out of an organisation. In addition, Stevens (1989) emphasises that internal integration is a necessary step that must be embarked on before external integration can be achieved. Internal integration is an initial stage toward accomplishing supply chain integration (Handfield & Nichols, 1999; Rosenzweig et al., 2003; Stevens, 1989). Stevens (1990) emphasise that internal supply chain integration needs functions in an organisation to be co-ordinated and integrated to achieve customer value and satisfaction.

In a recent study conducted by Mollenkopf, Russo, and Frankel (2007, p. 568) reports that “cross-functional integration within the firms is broader than was expected; the more integrated firms deal better with external factors influencing the returns management process.” This finding confirms the results of the previous studies in the literature (e.g., Burnell, 1999; Stock & Lambert 2001;

Mollenkopf & Dapiran, 2005) with regard to external integration. However, Mollenkopf et al. (2007, p. 581), noted from the interviews that the “integration mindset appears to exist only at the senior level of the firm, not at the operational level.” Another interesting outcome from the Mollenkopf et al.’s (2007) study is that one of the five companies interviewed emphasised that “the strong personal working relationships of people across functions as a key reason why integration has improved” (Mollenkopf et al., 2007, p.581). One firm’s senior manager pointed out that organisational culture is salient to supply chain integration (Mollenkopf et al., 2007).

Lambert and Cooper (2000) argue that the first step towards integration in a reorganisation of the SC in a company should be based on business processes, to remove functional barriers. Therefore, internal integration will stress the achievement of a seamless integration of organisational functions (logistics, production, etc.) that is facilitated by reorganising the organisational structure around the key business processes (Daugherty et al., 1996; Lambert & Cooper, 2000). Focal organisations or strong leaders drive SCM initiatives, and top management commitment from all organisations participating in the SCM initiatives is required to achieve supply chain integration.

Daugherty et al. (1996) emphasize the need for cultural compatibility between supply partners to enhance integration efforts. Ghoshal and Bartlett (1995) also stress the need for a common ground between SC partners to improve communication, trust and knowledge transfer throughout the SC. Handfield, Krause, Scannell and Monczka (2000) and Chopra and Meindl (2001) argue that a major focus of the collaboration is to align goals and incentives within the SC to maximize the total SC profits. Pagell (2004) state that the requirement to integrate internal functions is a challenge facing many organisations.

2.4.4 External supply chain integration

External integration is composed of integration of an organisation with key suppliers and customers (Lambert et al., 1998; Lambert et al., 1996). External integration with suppliers is defined by many researchers as the degree of co-ordination between manufacturer and its upstream partners (e.g., Peterson, Handfield, & Ragatz, 2005; Koufteros, Van Vonderembse, & Jayaram, 2005; Stevens, 1989; Narasimhan & Jayaran, 1998; Frohlich & Westbrook, 2001, 2002; Kim & Narasimhan, 2002; Narasimhan & kim, 2002; Frohlich, 2002). In addition, external integration with customers is defined as the degree of coordination between manufacturer and its downstream customers (e.g. Koufteros, Van Vonderembse & Jayaram, 2005; Bowersox, 1989; Stevens, 1989; Narasimhan & Jayaram, 1998; Frohlich & Westbrook, 2001, 2002; Kim & Narasimham, 2002; Narasimhan & Kim, 2002; Frohlich, 2002).

The company must work closely with suppliers and customers in order to improve the suppy chain performance (Narasimhan & Kim, 2002). There is a high correlation between integration with suppliers, customers and an organisation's performance (Frohlich & Westbrook, 2001; Rosenzweig et al., 2003). One approach is internet-based SCI, which has been praised in the literature. Frohlich (2002) found the following from his study of e-integration in the supply chain: (i) a positive connection between e-integration and performance; and (ii) internal barriers hindered e-integration more than either upstream supplier barriers, or downstream customer barriers.

Many companies are reported in the literature to be currently adopting integrated supply chain management and focusing on establishing processes that reduce or eliminate inventories. The study on the role of supply chain management decisions in effective inventory control conducted by Alade and Sharma (2004, p. 183) revealed that "through integration, and by partnering with upstream and downstream players of supply chain, companies have demonstrated improved ability to manage and deliver products to customers in the correct quantities, with correct specifications, at the correct time, and at a competitive cost." In addition, the authors warned that businesses that concentrate only on cost control will miss out on revenue-making opportunities (Alade, et al., 2004).

2.4.5 Value of information technologies in supply chain integration

The information technology (IT) as a source of competitive advantage is well-covered in the literature (e.g., Porter & Millar, 1985; Johnson & Vitale, 1988;

Mata, Fuerst, & Barney, 1995; Barney, 1991). Information technologies have reduced coordination costs and the risks associated with inter-organisational relationships (Malone, Yates, & Benjamin, 1987; Morrell & Ezingeard, 2002). IT enables buyers and suppliers to communicate using easy to use information channels, at reduced costs (Lewis & Talalayevsky, 2000).

The information systems and technologies in supply chains are some of the most important elements that “link” the organisations of a supply chain into a unified and coordinated system (Handfield & Nichols, 1999). McAfee (2002) also found that there is a causal link between IT adoption and later improvement in operational performance. The findings of Gonzalez, Quesada, Urrutia, and Gavidia (2006) support that of McAfee (2002). Gonzalez et al. (2006, p. 155) revealed that “information and communication technologies provide opportunities to increase the quality and efficiency of healthcare services by improving communication within and across systems.”

As noted previously, IT has been the prime facilitator of SCI. IT has the potential to provide the information required to reorganize the SC so that it can be more integrated (Chandra & Kumar, 2001a). However, although information is important to SCM, compatibility issues between business partners hinder cross-enterprise integration (Chandra & Kumar, 2001b). Integration using e-commerce and internet provide low cost alternative to other SCI systems, such as Enterprise Resource planning (ERP) systems. ERP (Rayport & Jaworski, 2001; Robinson & Winson, 2001) and the mySAP SCM application (SAP-SCM, n.d.) provide an internal organisational connectivity. In addition, Gotteleer and Bendoly (2006) emphasise the use of ERP in an organisation, and Troyer, Smith, Marshall, and Yaniv (2005) reported benefits, such as improvement of service levels in an organisation after implementing an enterprise wide system.

A study conducted by Cotteleer and Bendoly (2006) revealed that an organisation that implemented Enterprise Resource Planning (ERP) resulted in significant continuous improvement in order fulfilment lead-time. Troyer et al. (2005) reported the success of the U.S. company Deere’s Commercial and Consumer Equipment in using enterprise-wide system integration. They stated that “Deere improved its factories’ on-time shipments from 63 percent to 92 percent, while maintaining customer service levels at 90 percent through use of ERP. Between 2001 and 2003, Deere reduced or avoided inventory by $890 million, improving annual shareholder value added (SVA) by $107 million” (Troyer, et al., 2005, p. 76).

However, Stefanou and Revanoglou (2006, p. 127) argue that the use of ERP in a hospital “does not automatically imply the existence of fully integrated processes, procedures, applications, and daily administrative functions”. Several specialized clinical and hospital departments have stand alone information systems e.g., picture archiving and communication system (PACS) and the laboratory information system (LIS). Stefanou and Revanoglou recommend that seamless integration among ERP and other non-ERP systems will provide greater efficiency (Stephanou & Revanoglou, 2006).

2.4.6 Benefits of SCI

Fawcett and Magnan (2001, p. 34) and Fawcett, Magnan and McCarter (2008, p. 43) identified the following benefits of supply chain integration, arranged in order of priority: “(1) respond to customer requests, (2) on-time delivery, (3) customer satisfaction, (4) order fulfilment lead times, (5) cost of purchased items, (6) firm profitability, (7) handle unexpected challenges, (8) inventory costs, (9) overall product cost, (10) productivity, (11) overall product quality, (12) transportation costs, (13) market penetration, (14) product innovation lead times, and (15) cost of new product development.”

2.4.7 Barriers to effective SCI

Fawcett and Magnan (2001, p. 37) and Fawcett et al. (2008, p. 43) identified the following barriers to effective supply chain integration, arranged in order of priority: (1) inadequate information systems, (2) lack of clear alliance guidelines, (3) inconsistent operating goals, (4) lack of shared risks and rewards, (5) processes poorly costed, (6) non-aligned measures, (7) lack of willingness to share information, (8) organizational boundaries, (9) inappropriate measures of

SC contribution, (10) inappropriate measures of customer demands, (11) lack of employee empowerment, and (12) lack of resources for SCM.

The items 8, 9 and 10 are barriers because of the following reasons:

- “It is simply impossible to coordinate value added activities across functional and organizational boundaries without shared information
- Difficulty in evaluating the contribution of each supply chain member
- Lack of systematic approach to measure customer requirements” (Fawcett & Magnan, 2001, pp. 37, 39) .

2.5 Health care supply chain integration

2.5.1 Health care supply chain

Ghobadian and Ashworth (1994) found that productivity of the service industry sector has remained static and that in particular measurement of performance in a local authority is difficult. A recent study by Bagchi and Chun (2005) found that SCI influences operational performance, and the extent of integration also has a positive impact on cost and efficiency. Despite this, little evidence is found in the literature regarding the major operational issues which have an impact on SCI, supplier commercial relationships, and order fulfilment in the hospital sector. The conference of Production and Operations Management Society (2006, April 28 – 1 May) noted negative publicity regarding the perceived inefficiencies within the health care industry and noted that supply chain in the health care sector was not well researched.

Health care organisations in all countries are looking for ways to improve operational efficiencies and reduce costs without affecting patient care services. The study conducted by Byrnes concerning inefficiencies in the health care supply chain in the U.S. revealed that " the healthcare industry has developed some of the most important supply chain innovations. In the mid-1980s, Federal regulations severely crimped hospital budgets. In response, a particular innovative hospital supply company developed one of the first powerful vendor managed inventory systems, which greatly reduced costs and increased service at the same time" (2004, April, p. 1). Health care budgets are very tight generally, and that is why health providers worldwide are striving to improve processes and reduce costs. Savings in the health care supply chain are reported in a study by the Ontario Hospital Association Task Force (2001, November). Their study revealed that the potential value of SCM improvement in the Ontario hospital sector is estimated at more than Canadian $ 300 million a year.

Although information technology has been seen as a catalyst for cost savings, Novelli (2004, p. 32) cautions that technology is a means, not an end in itself. He also provides examples of health care in the U.S. where he finds that information technology is not effectively or routinely applied to the practice of medicine, noting that “more than 90% of the 30 billion annual medical transactions are conducted by phone, fax or stamped mail … Only one third of hospitals have computerized order-entry systems and fewer than 55 require their use. Only 5% of clinicians and 195 of provider organizations use electronic medical records … fewer than 5% of physicians write electronic prescriptions.”

2.5.2 Supply chain integration in the health sector

The situation in the health sector regarding SCI lags behind that of manufacturing and other service sectors. Byrnes (2004, April, p. 1) states that "25 percent of hospital costs in the U.S. are supply related.” The opportunity costs of supply chain inefficiency are enormous. With limited hospital budgets, supply chain inefficiencies consume resources that could be used to make important therapies more available (Byrnes, 2004). Hersch and Pettigrew (2002, p. 41) also emphasize that "with hospital budgets stretched and margins flat, a more efficient supply chain not only can add to the financial bottom line, it also can reduce the time health care workers spend in administrative duties, allowing them to focus on delivering quality patient care." In addition, Hersch and Pettigrew (2002) claim that group purchasing can reduce hospital supply chain expenses by 5% to 15%.

Harland's (1996, p. 187) research on supply network strategies in the health sector revealed that "there is a wide variety of supplies purchased for healthcare, which involve many different relationships of different types being formed in complex networks of supply from original source to end customer." McGrath and More (2001) stated that poorly integrated information systems, certainly comprise a main problem within the Australian healthcare sector. They reported on some outcomes of a recent study of a major Australian e-commerce project designed to improve pharmaceutical supply chain efficiency within the healthcare sector and revealed that "the standards that underpinned the project seem to have resulted in improved levels of data and systems integration - both within and between organisations" (p.1). The importance of integration was also emphasized by Brennan (1998, Jan. p. 31) who commented that "healthcare organisations should include the whole supply chain in their integrated delivery systems (IDS). Managing the supply chain process with the aid of IDSs will help healthcare providers achieve service efficiencies that will translate into long-term success." McGrath and More's (2001) study of the use of e-commerce to improve Australian pharmaceutical supply chain efficiency within the healthcare sector reveals that e-commerce improved levels of data and systems integration. They warned that poorly integrated information systems can worsen the inter-organisational e-commerce applications (McGrath & More, 2001).

An integrated healthcare system is provided by Oracle (n.d.). In order to reduce costs and improve services, Oracle offers SCM for healthcare, and its benefits include: procurement costs reduced by as much as 20 percent, increased efficiencies in the healthcare supply chain and shortened lead times, etc. It reduces cost through improved decision-making about product costs, terms and choice of vendors. "Thousands of healthcare organizations around the world rely on Oracle to help them increase clinical performance and integrate business processes across the entire healthcare continuum:

- 10 of the top 12 of Fortune Magazine's global 500 healthcare organizations run Oracle Applications
- 70 percent of the top multi-hospital systems in the United States run Oracle technology." (Oracle, 2008).

Nevertheless, Zheng et al. (2006) in their study of e-adoption in healthcare supply chains in the English National Health Service (NHS), revealed that there is limited use of e- commerce in supply chains in this sector.

2.5.3 Outsourcing in public hospitals

Most studies of supply chain integration in health care sector have concentrated on outsourcing, and information regarding supply chain integration in public hospitals is limited. In order to reduce health care costs, providers are shifting to outsourcing in an attempt to maintain high standards of health care (Sarpin & Weideman, 1999). A study by Moschuris and Kondylis (2006, p. 4) on outsourcing in public hospitals in Greece revealed that cost savings and customer satisfaction are the key factors affecting the outsourcing decision. In addition, they found that the collaboration/cooperation with a contract service provider had significant improvement in service quality (Moschuris & Kondylis, 2006). Moreover, Homburg, Hoyer and Fassnacht (2002), and Lytle and Timmerman (2006) suggest that organisations focusing their activities on the requirements of their customers perform better, and achieve long-term goals and improve finance performance.

The usage of outsourcing in health care has been widely investigated in the U.S.A (Gardner, 1991; Solovy, 1996; Hensley, 1997; Triulzi, 1997; Hensley, 1998; Ngeo, 1998; Smyth, 1998; Sunseri, 1998; Blouin & Brent, 1999; Katzman, 1999; Morrissey, 1999; Wholey, Padman, Hamer, & Schwartz, 2001; Lorence & Spink, 2004; Nicholson, Vakharia, & Erenguc, 2004). Lorence and Spink (2004) found six factors that influence managers' information system outsourcing decisions: improved patient care, cost savings, regulations, competition, trained staff availability, and space considerations. Nicholson et al. (2004) found not only outsourcing results in inventory cost savings but also does not compromise the quality of care as reflected in service levels. Studies which examine the usage of contract service providers in health care in other countries have been conducted by many researchers, including for example in U.K. (Mark, 1994; Smyth, 1998; Heavisides & Price, 2001; Riley, 2001), in New Zealand (Cameron, 1998; Renner & Palmer, 1999), and in Canada (Chow & Heaver, 1994; Rivard-Royer, Landry, & Beaulieu, 2002). All these studies concluded that: health care organisations outsource different types of activities (e.g., pre-packed products, packing formats, re-arrangement of storage areas, stockless agreements, and logistics activities), and key benefits from using outsourcing services are improved performance, cost savings, and increased management time spent on core business. Rivard-Royer et al. (2002) highlighted the disadvantage of outsourcing. They found that the labour union in Quebec due to fear of losing jobs did not accept the Canada's government - controlled healthcare system, using the hybrid version of stockless system.

2.5.4 Group purchasing in hospitals

There is a wide range of supplies purchased for health care, which involve many different relationships of different types being formed in complex networks of supply from the supplier to end customer. Nollet and Beaulieu (2005, p.12) define a purchasing group "as a formal or virtual structure that facilitates the consolidation of purchases for many organisations. Consolidation is a procurement practice used to transfer to a central entity activities such as: bidding, supplier evaluation, negotiation, and contract management." Furthermore, Rozemeijer (2000) emphasise that a purchasing group normally provides extra power to the members of the group in their negotiations with suppliers. As a result, members get more favourable conditions than those which they would have gained individually. Young (1989) says that a purchasing group is an additional link in the supply chain. Fenstermacher and Zeng (2000) argue that a purchasing group increases the distance between buyers and sellers.

A study by Nollet and Beaulieu (2005, p.11) on "Should an organisation join a purchasing group?" found that "a purchasing group increases volume consolidation, making it possible to have only one negotiation, in order to increase purchasing group members' power vis-à-vis that of its suppliers. However, a purchasing group also constitutes an additional link in the supply chain and its objectives could go contrary to those of some of its members" (Nollet & Beaulieu, 2005, p.11).

Anderson and Katz (1998) highlight three types of cost reduction for which purchasing can generate benefits: price, administrative costs, and assets utilisation costs. Purchasing groups create savings of between 10 per cent and 15 per cent (Hendrick, 1997; Schneller, 2000). However, Scanlon (2000, p. 2) found that prices negotiated by purchasing groups “were not always lower and were often higher than prices paid by hospitals negotiating with vendors directly.”

Chapman, Gupta, and Mango (1998) state that the real savings in the health care sector come from product standardisation, and they warn there is a need to be careful as to how far purchasing groups can create savings. Although purchasing groups are gaining importance in the health sector in the world, the majority of purchasing groups, between 600 and 700, are in the U.S. health-care industry (Burns, 2002).

In recent years, group purchasing in hospitals has been developing. For example, seven hospitals in the Pittsburgh, PA, area in the U.S. merged to create a purchasing cooperative/group in order to keep prices cost effective (Foodservice Director, 1998, p.18). The value of group purchasing in the health care supply chain has been emphasized by Scheller and Patton (n.d.). The result from their study indicates that most of the leading hospitals perceive outsourcing the contracting and supplier negotiation process using group purchasing order (GPO) as a major strategic SCM choice. The findings are supported by the U.K. Department of Health (DH), which has recenty selected as its preferred outsource bidder DHL/Novation, a consortium made up of German logistics company and a U.S. health care contractor (Ellinor, 2006, May, p. 7).

The National Health Service (NHS) in England spends Pounds 15 billion per year on purchased goods and services (NHS, 2004). The NHS Purchasing and Supply Agency (PASA) was established in year 2000 to act as a strategic adviser to the NHS on all supply issues. PASA (April 2002 and February 2004) claim to have achieved savings for NHS totalling Pounds 580 million over the three year period between April 2000 and April 2003. Another example of benefits of group buying is that of the Voluntary Hospital of America Inc. (VHA)

(April 29, 2004), a U.S. not-for-profit hospital co-operative with 2200 members, which estimated its members saved U.S.$ 813.5 million using group buying on purchases of U.S.$ 17.7 billion in 2003. All of this is evidence of the importance of SCM in the health care system.

Pharmaceutical Management Agency (Pharmac) in NZ fulfills similar role of group services like PASA in England. Pharmac's role is to manage funding of community pharmaceuticals on behalf of the DHBs and acts as the agent in deciding which medicines are funded. In addition, Pharmac provides DHBs with national procurement pojects and assessment of hospital pharmaceuticals (Pharmac, 2010).

4.5.5 Organisational culture

Schein (1980, p.111) defines culture as "a pattern of basic assumptions that a group has invented, discovered or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems." O'Reilly, Chatman, and Caldwell (1991, p. 491) define culture as "a set of cognitions shared by members of a social unit." Lysons and Farrington (2006, p. 50) define culture as "the system of shared values, beliefs and habits within an organisation that interacts with the formal structure to produce behavioural norms." They also refer to culture as an ingredient of SCM.

The literature suggests that there are variations between employee's perceptions concerning the required form of organisational culture, based on whether they hold a managerial or non-managerial position (Schneider, White, & Paul, 1998). Employees' different role within the organisation can cause variations in perceptions. A study conducted by Bellou (2007, p. 514) in the health-care sector regarding achieving long-term customer satisfaction through organisational culture found that there "is still a lot that needs to be done in order to meet customer needs." This result confirms the finding of Jakubowski and Busse (1998) who stated that hospitals in the European Union face serious challenges due to lack of capability to provide services of high quality.

Furthermore, Bellou (2007) revealed that there is a positive correlation between organisational culture and customer service orientation.

IMTI, Inc. (2007, n. p.) found that “a culture of trust and innovation enables corporations to achieve breakthrough levels of business performance. This performance achievement is realised through a shared vision of success in which everyone has a defined role and clear incentives and rewards. The supply chain is a partnership with common objectives, including management of total cost and risks.” Trkman and Groznik (2006) state that different organisational cultures and leadership styles be aligned to suit the SC and that “organizational culture importance must be emphasized” (Trkman & Groznik, 2006, p. 42). Corporate culture and the management techniques of each organisation in a supply chain should be compatible for successful SCM (Cooper et al., 1997a; Cooper et al., 1997b; Lambert, Stock, & Ellram, 1998b).

2.6 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 Van 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.

2.6.1 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 consistent with qualifying and order winning criteria for competitiveness (Corbett & Van Wassenhove, 1993).

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). Van 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” (Van 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). Morrell and Ezingeard (2002) stress on the use of inter-organisational information systems in order to improve supply chain performance.

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 that “Each functional area viewed itself as very supportive of SCM while identifying the other functional areas as less engaged or even obstructive.”

2.6.2 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).

2.6.3 Performance improvement and SCI

Kim (2006a, 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, 2006a, 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, 2006b, 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.

2.6.4 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 comprehend the operations of organisations, and to improve organisational performance, it is important 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).

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.

2.6.5 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).

2.7 Supplier commercial relationships

2.7.1 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.”

2.7.2 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).

2.7.3 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).

2.8 Focused supply chain integration

This study measures SCI using a new focused supply chain integration (focused SCI) measurements based on organisational management behavioural aspects. SCI has many definitions in the literature but they are less focused on management behavioural issues. For this reason, the 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. Focused SCI measures have been used 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, supplier commercial relationships, and order fulfilment. Focused SCI is likely to have impact on order fulfilment.

2.9 Order fulfilment

2.9.1 Order fulfilment process

The dependent variable for this study is order fulfilment. Order fulfilment is a measure of the effect of the independent variables (SCI operational issues, supplier commercial relationships, and focused SCI) on the set of measurements / issues likely to have impact on order fulfilment. The order fulfilment construct is composed of measures developed from the literature and interviews (see section 4.10.1).

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). Therefore, the differences in order fulfilment processes for various goods need to be studied.

2.9.2 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).

2.9.3 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).

2.9.4 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 determines the critical factors that enhance order fulfilment in the public hospitals. The assumption is that SCI operational issues have impact on supplier commercial relationships, focused SCI, and order fulfilment. Therefore, order fulfilment is dependent on improved SCI operational issues, supplier commercial relationships, and focused SCI. The research on this relationship has not been conducted in the public health sector. Little is known regarding how public hospitals achieve SCI. This study is designed to fill this gap in the literature.

2.10 Supply chain integration studies in New Zealand

Campbell (2002, p.120) and Campbell and Sankaran (2005) studied two SMEs organisations (NZ Com and Build Com) in NZ with reference to SCI, and a major finding was that SCI has three distinct dimensions (internal integration, backward or external integration with suppliers, and forward or external integration with customers). However, the study did not identify critical factors influencing the SCI and their impact on supplier commercial relationships and order fulfilment. The aim of the research was to develop a framework for assessing the extent of SCI in the supply chain. The validity of their framework can be challenged as it was developed from experience with only two organisations.

A comprehensive study conducted by Basnet, Corner, Wisner and Tan (2003) highlighted that the situation regarding SCI is no better in New Zealand and confirms that NZ is lagging behind the U.S. and Europe. Basnet et al. (2003, p. 63) noted that in NZ, "… there has not been much progress when it comes to more advanced ideas such as supply chain teams, or information sharing, or use of EDI, etc." They concluded from their survey data that future research opportunities existed in the identification and validation of SCM techniques and practices that are particularly suited to manufacturing industries in NZ.

The results of a recent online survey of the panel of experts conducted by Childerhouse (2007) indicate that the two key barriers for achieving supply chain excellence in New Zealand are: lack of understanding of supply chain integration and lack of internal buy-in to supply chain concepts. The results support the findings of Basnet et al. (2003). In addition, Childerhouse (2007) identified secondary barriers: staff's resistance to change and a significant lack of human resource expertise, and concluded that there is a need for a dynamic workforce that supports new concepts and is willing to learn modern management concepts.

2.11 Conclusions from the literature review

This chapter shows that the literature on SCI is widely covered, and its meaning in practice and definitions in theory vary across different disciplines. The methodology to enhance or initiate SCI adopted in the organisations differ between organisations. The theoretical and practical implications of SCI differ also across disciplines. There has been a range of frameworks / methodologies used for SCI initiatives. SCOR (Supply Chain Council, 2001) and eight supply chain business processes identified by members of The Global Supply Chain Forum (Lambert, 2004; 2008) have been widely used in practice. Although there are remarkable benefits of SCI, the adoption of SCI in organisations has not been easy. The literature indicates that there are many barriers hampering the implementation of SCI (e.g., Halldorsson et al., 2008; Fawcett & Magnan, 2001, 2008; Barratt, 2004; Frohlich, 2002).

It is evident that SCI has been considered as a means to reduce operations costs and supply chain inefficiencies, and improve service level in an organisation. Lack of integration between internal and external members of a supply chain results in operational inefficiencies and hinder the performance of the supply chain and order fulfilment. There are different views regarding SCI. Some researchers have emphasised on the need for holistic SCI (e.g., Sundaram & Mehta, 2002; Power, 2005) and other researchers stress on the need for semi-integration (e.g., Bask & Juga, 2001). The main observation from the literature is that there is a need to study SCI in different sectors in order to understand the nature of SCI initiatives and its implementation. Bagchi and Chun (2005) found that SCI influences operational performance, and the extent of integration also has a positive impact on cost and efficiency. Apart from the benefits of SCI in organisations, the research on SCI operational issues and their impact on supplier commercial relationships, focused SCI, and order fulfilment in the public health sector is nonexistent. This research is aimed to fill this gap in the literature.

Early SCI research has focused mostly on the management process integration issues related to the manufacturing sector and less on service sector. Production and Operations Management Society found that supply chain in the health sector was not well researched (2006, April 28 – 1 May). Little is known concerning how public hospitals attain SCI. It is thus evident that there are still gaps in SCI knowledge in determining the factors which influence supplier commercial relationships, focused SCI, and order fulfilment in public hospitals.

The purpose of this research is to identify critical factors or operational issues that affect SCI in the New Zealand public hospitals. The SCI influences and their impact on supplier commercial relationships and order fulfilment are examined critically. The research seeks to answer the following questions (stated in chapter 1) in order to address current major knowledge gaps in the literature:

- What are the critical operational factors influencing supply chain integration in NZ public hospital sector?
- 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?
- How can the public hospital sector enhance supply chain integration to improve supplier commercial relationships and to achieve the order fulfilment goals?
- What are barriers to SCI practices in public hospitals?

In addition, the hypotheses tests linked to the above research questions (chapter 3) are conducted. The next chapter three presents the research model development and the hypotheses for this study.

Table 2.2 Literature Review: Theoretical Perspectives

Supply chain management theories:

Lambert et al. (1998a)	Bowersox et al. (1999)
Srivastava, et al. (1999)	Skjoett-Larsen (1999)
Melnyk et al. (2000)	Mentzer et al. (2001)
Croxton, et al. (2001)	Mentzer (2001, 2004)
Madhok (2002)	Supply Chain Council (2003)
Akkermans et al. (2004)	Lambert (2004)
Lambert et al. (2005)	Storey et al. (2006)

Process-based management theory:

Christopher (1992)
Porter (1997)
Van Hoek (1998a and b)
Lambert et al. (1998a)
Akkermans et al. (1999)
Fawcett & Magnan (2001)
Hammer (2001)
Lambert (2004)
Lambert (2008)

Table 2.3 Literature Review: Supply Chain Management

Definitions of SCM:
Cooper & Ellram (1993) Lambert et al. (1998a) Christopher & Ryals (1999) Chandra (2000) Tracey & Smith-Doerflein (2001) Handfield & Nichols (2002) Desouza et al. (2003) Msimangira (2003) Lambert (2004) CIPS (2007) Basu & Wright (2008) Morey (1997) Delaney (1999) Bowersox et al. (1999) Dershin (2000) Mentzer et al. (2001) Chan & Qi (2003) Sadeh et al. (2003) Gowen & Tallon (2003) Cox (2004) ISM (2007)
Benefits of SCM:
Magretta (1998) Lee & Whang (1999) Simchi-Levi et al. (2003) Storey et al. (2006)
Problems of SCM:
Forrester (1961) Fransoo & Wouters (2000) Holweg & Bicheno (2002) Turban et al. (2004) Gunasekaran et al. (2004)
Integration:
Lambert (2004) Lambert (2008)

Table 2.4a Literature Review: Supply Chain Integration

Supply chain integration:	
Stewart (1997)	Narasimhan & Jayanam (1998)
Lee & Whang (1999)	Cox (1999)
The National Research Council (2000)	Lamber & Cooper (2000)
Towill et al. (2000)	Lee (2000)
Narasimhan et al. (2001)	Stock & Tatikonda (2000)
Stephens (2001)	Supply Chain Council (2001)
Stank et al. (2001)	Frohlich & Westbrook (2001)
Hill & Scudder (2002)	Hammer (2001)
Kim & Narasimhan (2002)	Li (2002)
Morrell & Ezingeard (2002)	Frohlich (2002)
Frohlich & Westbrook (2002)	Narasimhan & Kim (2002)
Rosenzweig et al. (2003)	Simchi-Levi et al. (2003)
Yusuf et al. (2004)	Marquez et al. (2004)
Zailani & Rajagopal (2005)	
Semi-integration:	
Bask & Juga (2001)	Sundaram & Mehta (2002)
Fawcett & Magnan (2002)	Van Donk & Van der Vaart (2005)
Power (2005)	Ho & Chi (2005)
Internal and external supply chain integration:	
Stevens (1989)	Byrnes & Markham (1991)
Hewitt (1994)	Daugherty et al. (1996)
Bowersox & Closs (1996)	Burnell (1999)
Stock & Lambert (2001)	Narasimhan & Kim (2002)
Barratt (n.d.)	Pagel (2004)
Dapiran (2005)	
Internal supply chain integration:	
Stevens (1989)	Stevens (1990)
Ghoshal & Bartlett (1995)	Daugherty et al. (1996)
Carter & Narasimhan (1996)	Birou et al. (1998)
Narasimhan & Carter (1998)	Wisner & Stanley (1999)
Handifield & Nichols (1999)	Burnell (1999)
National Research Council (2000)	Lambert & Cooper (2000)
Handfield et al. (2000)	Lambert & Cooper (2001)
Chopra & Meindl (2001)	Stock & Lambert (2001)
Rosenzweigh et al. (2003)	Pagell (2004)
Mollenkopf & Dapiran (2005)	Mollenkopf et al. (2007)

Table 2.4b Literature Review: Supply Chain Integration (cont.)

External supply chain integration:	
Lambert et al. (1996)	Lambert et al. (1998)
Narasimhan & Jayaran (1998)	Stevens (1999)
Frohlich & Westbrook (2001)	Frohlich & Westbrook (2002)
Kim & Narasimhan (2002)	Narasimhan & Kim (2002)
Frohlich (2002)	Rosenzweig et al. (2003)
Alade & Sharma (2004)	Koufteros et al. (2005)
Peterson et al. (2005)	
Value of information technologies in supply chain Integration:	
Porter & Millan (1985)	Malone et al. (1987)
Johnson & Vitale (1988)	Barney (1991)
Mata et al. (1995)	Handifield & Nichols (1999)
Lewis & Talalayevsky (2000)	Chandra & Kumar (2001a&b)
Payport & Jaworski (2001)	Robinsons & Wilson (2001)
McAfee (2002)	Morrell & Ezingeard (2002)
Smith et al. (2005)	Troyer et al. (2005)
Gonzalez et al. (2006)	Cotteleer & Bendoly (2006)
Stefanou & Revanoglou (2006)	SAP-SCM (n.d.)
Benefits of supply chain integration:	
Fawcett & Magnan (2001)	Fawcett et al. (2008)
Barriers to effective supply chain integration:	
Fawcett & Magnan (2001)	Fawcett et al. (2008)

Table 2.5 Literature Review: Health Care Supply Chain Integration

Health care supply chain:	
Ghobadian & Ashworth (1994)	
Ontario Hospital Association Task Force (2001)	
NHS Purchasing and Supply Agency (2002)	
NHS Purchasing and Supply Agency (2004)	
Novelli (2004)	Byrnes (2004)
Voluntary Hospital of America Inc. (2004)	
Bagchi & Chun (2005)	
Production and Operations Management Society (2006)	
Supply chain integration in health sector:	
Harland (1996)	Brennan (1998)
McGrath & More (2001)	Oracle (n.d.)
Hersch & Pettigrew (2002)	Byrnes (2004)
Zheng et al. (2006)	
Outsourcing in public hospitals:	
Gardner (1991)	Mark (1994)
Chow & Heaver (1994)	Solovy (1996)
Hensley (1997)	Triulzi (1997)
Hensley (1998)	Ngeo (1998)
Smyth (1998)	Sunseri (1998)
Cameron (1998)	Sarpin & Weideman (1999)
Katzman (1999)	Morrissey (1999)
Renner & Palmer (1999)	Blouin & Brent (1999)
Wholey et al. (2001)	Heavisides & Price (2001)
Riley (2001)	Homburg et al. (2002)
Rivard-Royer (2002)	Lorence & Spink (2004)
Nicholson et al. (2004)	Lytle & Timmerman (2006)
Moschuris & Kondylis (2006)	
Group purchasing in hospitals:	
Young (1989)	Hendrick (1997)
Anderson & Katz (1998)	Chapman et al. (1998)
Foodservice Director (1998)	Rozemeijer (2000)
Fenstermacher & Zeng (2000)	Scanlon (2002)
Scheller (2000)	Burns (2002)
Nollet & Beaulieu (2005)	Ellinor (2006)
Scheller & Patton (n.d.)	Pharmac (2010)
Organisational culture:	
Schein (1980)	O'Reilly et al. (1991)
Cooper et al. (1997a)	Cooper et al. (1997b)
Lambert, et al. (1998b)	Schneider et al. (1998)
Busse (1998)	Trkman & Groznik (2006)
IMTI, Inc. (2007)	Bellou (2007)

Table 2.6 Literature Review: Supply chain integration operational issues

Supply chain integration issues:	
Akkermans et al. (2003)	Barki & Pinsonneault (2005)
Supply chain integration initiatives:	
Corbett & Van Wassenhove (1993)	Filippini et al. (1996; 1998)
Fawcett & Magnan (2001)	Braganza (2002)
Fawcett & Magnan (2002)	Danese et al. (2006)
Rai et al. (2006)	Van Donk et al. (2008)
Organisation strategy and SCI drivers:	
Stevens (1990)	Narasimhan & Jayaram (1998)
Martensen & Dahlgaard (1999)	Morash (2001)
Dangayach & Deshmukh (2001)	Fawcett & Magnan (2001)
Van Hoek et al. (2001)	Lummus et al. (2001)
Barratt & Oliveira (2001)	Johnson & Scholes (2002)
Lowson (2003)	Briscoe (2004)
Barratt (2004)	Raps (2005)
Performance improvement and SCI:	
Fawcett & Magnan (2001)	Frohlich & Westbrook (2001)
Sundarraj & Talluri (2003)	Briscoe et al. (2004)
Kim (2006a; 2006b)	Stratman (2007)
Organisation environmental forces:	
Daft (2000)	Fawcett & Magnan (2001)
Mullins (2002)	
Barriers to SCI	
Lee & Billington (1992)	Narasimhan & Jayaram (1998)
Christopher & Ryals (1999)	Frohlich & Westbrook (2001)
Ahmad & Schroeder (2001)	Cox et al. (2001)
Fawcett & Magnan (2001)	Dainty et al. (2001)
Frohlich (2002)	Barratt (2004)
Van der Vaart & Van Donk (2004)	Van Donk et al. (2008)
Halldorsson et al. (2008)	Fawcett & Magnan (2008)

Table 2.7 Literature Review: Supplier Commercial Relationships

Commercial relationships:	
Ganesan (1994)	Baily et al. (1998)
Carr & Pearson (1999)	Bowersox et al. (2000)
Cannon & Homburg (2001)	Golicic et al. (2002)
La Londe (2002)	Burt et al. (2003)
Quayle (2003)	Lambert (2004)
Kwon & Suh (2005)	Ulaga & Eggent (2006)
Pan & Pokharel (2007)	
Long-term relationships with key suppliers:	
Ragatz et al. (1997)	Narasimhan & Jayaram (1998)
Tan et al. (1998)	Narasimhan & Das (1999)
Frohlich & Westbrook (2001)	Johnsson & Zineldin (2003)
Lau & Goh (2005)	
Supplier participation in planning and design:	
Narus & Anderson (1996)	
Lin & Tseng (2006)	

Table 2.8 Literature Review: Focused supply chain integration

Focused supply chain integration:	
Lambert et al. (1998)	Anderson (2000)
Fawcett & Magnan (2001)	Frohlich (2002)
Wagner (2003)	Loebbecke (2007)
Fawcett et al. (2008)	Lambert (2008)

Table 2.9 Literature Review: Supply Integration Studies in New Zealand

Supply chain integration in New Zealand:
Campbell (2002)
Basnet et al. (2003)
Campbell & Sankaran (2005)
Childerhouse (2007)

Table 2.10 Literature Review: Order Fulfilment

Order fulfilment process:

Palmatier (1988)
Kritchanchai & MacCarthy (1999)
McCarthy (1999)
Viswanathan & Piplani (2001)
Shapiro (2001)
Duffy & Dale (2002)
Hanna et al. (2003)
Thirumalai & Sinha (2005)

Demand management – collaborative planning:

Lambert (2004)
Lee et al. (2004)
Crum & Palmatier (2004)
Balan et al. (2007)
Min & Yu (2008)

Inventory management in supply chain:

King & Phumpiu (1996)
Wilson (2004)
Dooley (2005)
Logistics Bureau (2007)

Cross-functional teams:

Davenport & Prusak (1998)
Smith & Farquhar (2000)
Sethi et al. (2001)
Alexander et al. (2005)
Chen (2007)
Mollenkopf et al. (2007)

CHAPTER 3.0: MODEL DEVELOPMENT

3.1 Introduction

This chapter describes the rationale for the model structure, conceptual framework (Figure 3.1), and hypotheses (Figure 3.2) developed for this study. As mentioned earlier, the objective of this research is to conduct an empirical study of supply chain integration in New Zealand public hospitals: impact on supplier commercial relationships and order fulfilment. The basic conceptual research model for this research (Figure 3.1) claims that supply chain integration operational issues: supply chain integration initiatives, organisation strategy and SCI drivers, performance improvement and SCI, organisation environment forces, and barriers to SCI have influence on supplier commercial relationships, focused SCI, and order fulfilment. As indicated in the model, the operational issues, commercial relationships and focused SCI factors are expected to determine (or lead to) the order fulfilment. In addition, critical factors related to management issues to maintain supply chain integration must be identified so as to have a focused SCI.

The conceptual research model used is indicated in Figure 3.1.

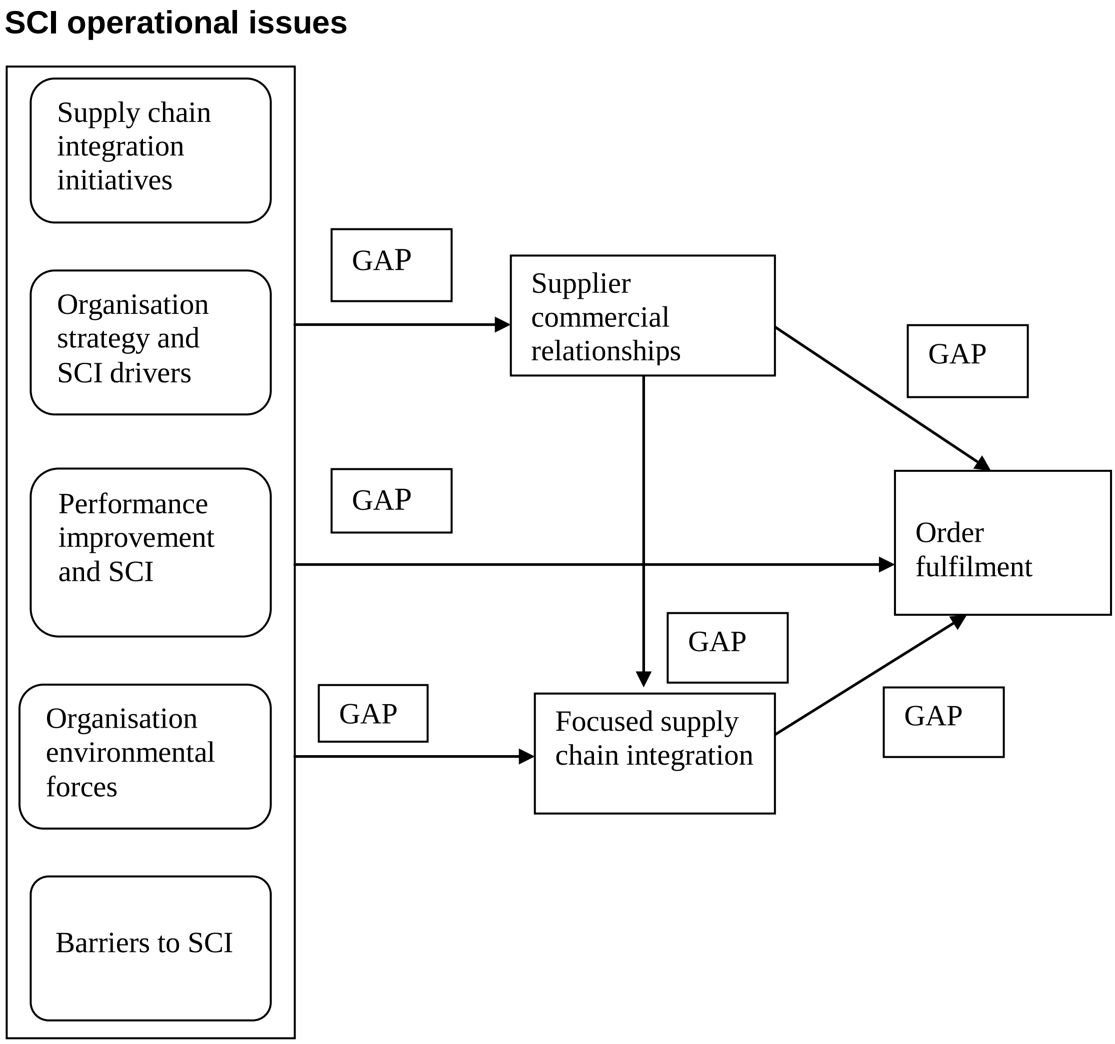


Figure 3.1: Conceptual Research Model: Factors influencing supply chain integration in New Zealand health public sector

The dependent variable is order fulfilment and the independent variables are: supplier commercial relationships, focused supply chain integration, and SCI operational issues from the literature and those which were identified in the interviews with purchasing and supply executives (detailed in chapter 4).

3.2 Rationale for the model structure

SCI has been acknowledged by academics and practitioners for reducing operations costs and improving service level. Nevertheless, little is known concerning how public hospitals attain SCI. This study aims to identify critical factors or operational issues that affect SCI in the New Zealand (NZ) public hospitals. Although the literature offers rich information on SCI in general, but there is no comprehensive clear validated survey questionnaire to measure SCI operational factors influencing supplier commercial relationships, focused SCI and their impact on the order fulfilment.

The SCI operational issues impact on supplier commercial relationships and order fulfillment are yet to be determined. In addition, the literature discusses SCI in mainly manufacturing sector, but offers no empirical validation regarding the public hospitals in the healthcare sector. Integration in supply chain has been emphasized by many researchers, for example, Bowersox, et al. (1999), and early adopters of SCI stress on the importance of SCI (e.g., Lee, 2000; Lee & Wolfe, 2000, 2003). The basic model structure helps to address the following questions regarding SCI in public health sector:

The key issue for the public hospitals is to minimize operations costs and improve service level to customers. The American National Research Council emphasizes on the need for suppliers and customers to work together (2000, p.27). However, Lambert et al. (1998) stress the need for 'integration of business processes'.

The hospitals need to identify critical operational issues / factors which have influence or impact on supplier commercial relationships, order fulfilment, and focused supply chain integration. Although the public hospitals are supposed to be integrated both internally and externally, it is important to identify management critical factors reinforcing internal and external integration, which will enable the public hospitals to determine a focused supply chain integration. The integration with both customers and suppliers is crucial but critical factors which add value must be known in order to maintain focused SCI in the hospitals. However, Mollenkopf and Dopiran (2005) found in their study that many organisations still focus their efforts more on internal integration issues.

The hospitals must identify critical operational issues influencing SCI and their impact on supplier commercial relationships and order fulfillment. It is important the hospitals to enhance SCI which is focused in order to reduce operational costs and improve service level to customers by meeting their requirements.

3.3 Conceptual Framework

Based on the research model structure given in Section 3.1, specific definitions of the constructs used in this research are discussed below:

3.3.1 Supply chain integration operational issues

SCI operational issues refer to the operational activities in the organisation that have impact on SCI integration. Slack, Chambers, and Johnston (2001) explain an operation as the transformation of customers, materials, and information in the production of outputs of goods and/or services. This research uses the following SCI operational activities adopted from the study conducted by Fawcett and Magnan (2001) and appear most in the literature: supply chain integration initiatives, organisation strategy and SCI drivers, performance improvement and SCI, organisation environmental forces, and barriers to SCI. All of the activities that make up a firm's operation relate to each other, and making these activities efficient means minimizing their total cost, and also the mixed set of activities support the firm's strategy (Chase & Aquilano, 2001). Also, Dilworth (2000, p. 5) argues that "all activities of an organisation are interdependent and must be well coordinated to make a company successful." Therefore, SCI operational issues in this research are measured as a multi-dimensional construct, and it includes the following areas:

- The extent of hospital engagement in supply chain integration initiatives adapted from Fawcett and Magnan (2001)
- Organisation strategy and SCI drivers (Fawcett & Magnan, 2001)

- Extent of the hospital SCI performance improvement (Fawcett & Magnan, 2001).
- Extent of importance of environmental forces to enhance SCI (Fawcett & Magnan, 2001)
- Barriers to SCI (Fawcett & Magnan, 2001).

Poor management of the operational issues can have a negative impact on the supply chain integration. Waller (2003) emphasize that the operations of the firm are driven by the strategy of the organisation.

3.3.2 Supplier commercial relationships

In this study, the construct supplier commercial relationships refer to the type of business relationships existing between a supplier and a customer. Lambert (2004, p. 21) defines supplier relationship management as the process that "provides the structure for how relationships with suppliers are developed and maintained." Baily, Farmer, Jessop, and Jones (1998) identify two main extremes of commercial relationships in the literature: adversarial (arms length) and partnership. However, some authors state that there are many types of supplier relationships (e.g., Sorce & Edwards, 2004) and different organisations emphasize on the certain types of business relationships. Golicic, Davis, McCarthy, and Mentzer (2002, p. 851) emphasize on relationship management as part of business strategy. However, in a study on defining business to consumer relationships conducted by Sorce and Edwards (2004, p. 255) revealed that "while some business-to-business relationship constructs are appropriate for understanding the nature of the business-to-consumer relationship, service quality dimensions are central to the consumer's definition of this relationship". In this study, the construct supplier commercial relationships, is intended to measure the nature of supplier commercial relationships in the hospitals. The construct includes the following measurement items:

- Reliable suppliers
- Promote partnership with dedicated suppliers
- Joint or collaborative planning
- Level of trust in buyer – supplier relationships

- Good communication with suppliers
- Level of strategic alliance with suppliers
- Suppliers prefer electronic purchasing
- Supplier development programme
- Service level agreement
- Contract to maintain relationship, and so on.

The construct is used to determine the extent of supplier commercial relationships practices in the public hospitals.

3.3.3 Focused supply chain integration

In the literature there are several definitions of SCI, but it is observed that management behavioural issues are not included in the definitions. Nonetheless in practice companies have been attempting to integrate supply chain activities, internally and externally, with channel partners (Clark & Stoddard, 1996; Henderson & Venkatraman, 1993; Kambil & Short, 1994).

In this study, focused supply chain integration includes management behavioural issues which may have impact on organisations ability to integrate management processes and corporate culture practices in the hospitals. It also denotes the nature of management orientation towards the customers and suppliers. Thus, the contention is that supply chain integration should be measured to determine the critical management behavioural factors enhancing supply SCI in the hospitals.

Different dimensions of measuring focused SCI were obtained from the interviews with senior purchasing and supply chain executives. It was found that there is a perceived need to manage the factors that improve quality of service, productivity, and customer value (focus). In addition, it is important to manage the processes that are critical to SCI in relation to the organisational culture. Schein (1992) defines culture as a system of norms, shared values, concerns, and common beliefs that are understood and agreed by the members of the organisation. Quality culture raises high-trust social relationships, and it brings up a shared sense of membership as well as a belief that continuous improvement is for everybody in the organization (Vouzas & Psychogios, 2007). Organisational culture is composed of the beliefs, values, norms, customs, and practices of the organisation (Ott, 1989). The organisational structures, routines, command and control expectations, and operational norms all have an effect on the organisational culture (Langfield-Smith, 1995).

The survey carried out by Rad (2006) on the impact of organisational culture on the successful implementation of total quality management (TQM) in hospitals found that organisational culture has a significant effect on the successful TQM implementation Therefore, the organisational cultural change is essential for the successful implementation of TQM. Furthermore, Rad (2006) found that 25 percent of hospitals had organic structure. "41.6 percent of hospitals had weak organisational culture versus 58.4 percent medium culture" (Rad, 2006, p. 606).

Top management support is required for any successful change in the organisation (Hamel & Prahalad, 1989; Dale, 1999; Balsmier & Voisin, 1996) to achieve an effective implementation of SCI. Narasimhan and Das (2001, p. 596) argue that purchasing integration is an internally focused practice. In addition, Miller (1982) stresses the need for alignment between the internal structural elements of the organisation.
Corbett and Rastrick (2000) emphasise that the most advantageous method to improve organisational output is to continually improve performance. Firms with high top management commitment make high quality products (Ahire & O'Shaughnessy, 1998). Furthermore, Chwalowski (1997); Kim and McIntosh (1999) in their researches into deregulating markets found that firms with focused strategies pre-deregulation continued to have focused strategies after deregulation.

In this study, the construct focused SCI is intended to measure the nature of focused SCI in the public hospitals, and it includes the following measurement items:

- Service functions are integrated
- National procurement policies and procedures
- An Enterprise Resource Planning (ERP) system
- An ERP system for health sector
- Priority to consultation with other departments
- Organisational culture that supports supply chain integration
- National supply chain integration policy
- Service integration
- Networking and relationships with suppliers
- Top management is committed to supply chain integration process
- Value supply chain management, and so on.

3.3.4 Order Fulfilment

The dependent variable in this study is order fulfilment. Most studies in the literature concentrate on different dimensions of SCI. This study assumes that operational issues, such as SCI initiatives, organisation strategy and SCI drivers, performance improvement and SCI, organisation environmental forces, and barriers to SCI, all may have impact on supplier commercial relationships, focused SCI, and more importantly, impact on order fulfilment.

Order fulfilment denotes the supplier's ability in meeting customer requirements. 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." Order fulfilment processes are different depending on the type of organisation (Dilworth, 2000, p. 94). Duffy and Dale (2002) state that order fulfilment is a major consideration for business to consumer operations.

The order fulfilment process is a key business process for achieving and maintaining competitiveness and is subject to re-engineering initiatives (Kritchanchai & MacCarthy, 1999). They also noted that firms have different emphasis on order fulfilment process due to the different problems faced in each environment (Kritchanchai & MacCarthy, 1999). For example, the level of safety stock requires significant attention for the oil and gas companies.

The order fulfilment is the focus of the study. In this study, the construct order fulfilment is intended to measure the performance of order fulfilment in the public hospitals, and it includes the following measurement items:

- Classify inventories according to their importance (importance means: critical, important, and non-critical)
- Reduced order fulfilment lead time
- Inventory policy of maintaining high level of inventory for critical items only
- Inventory policy for important items
- Supplier-buyer integrated order planning
- Suppliers (vendors) manage inventory
- Deliveries from suppliers are on time and right quantity
- Emphasise to suppliers that accuracy and efficiency of order fulfilment is important
- Improve supplier performance using order fulfilment metrics (measures), and so on.

3.4 Hypotheses

A literature review (chapter 2) on SCI, supplier commercial relationships, order fulfilment, and the pilot study (section 4.10.2) produced a conceptual model (Figure 3.1) and eighteen hypotheses (Figure 3.2). The hypothesized integration relationships were developed in line with the research objectives and research questions indicated in chapter 1. Thus, the hypotheses are linked to the research questions for this study, organised according the main conceptual areas defined in section 3.3. The hypotheses indicated in Figure 3.2 are exploratory and have not been empirically supported or tested. Armstrong, Brodie, and Parsons (2001) argue that an exploratory hypothesis is the suitable approach to increase knowledge about a phenomenon.

3.4.1 SCI operational issues

(See also sections 2.3 and 2.6)

In section 3.3.1, 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 is 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) emphasise that organisations should make their operations more flexible and responsive to their customers' requirements and order fulfilment. 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.

In summary, previous studies have shown that SCI operational issues have impact on the performance of an organisation. However, the influence of SCI operational issues on focused supply chain integration in the NZ public hospitals is not known. The proposed theoretical model for this research shows that SCI operational issues have a positive impact on focused SCI, except barriers to supply chain integration have a negative impact.

The following key hypotheses (H1a – H1e) for this research are considered to address the gap in the literature:

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.

3.4.2 Supplier commercial relationships

(See also section 2.7)

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.” Additionally, 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). Pint and Baldwin (1997) add 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. Likewise Spitzeberg (2000) stresses that an effective communication can produce the desired results and enhance relationship.

Accordingly, it is 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.

In summary, previous studies have emphasised on the importance of good relationships between a buyer and a supplier. However, less attention has been paid to the impact of supplier commercial relationships on focused SCI. The impact of SCI operational issues on supplier commercial relationships in public hospitals is unknown. Therefore, there is a need to investigate SCI operational factors that have significant impact on supplier commercial relationships.

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.

3.4.3 Order fulfilment

(See also section 2.9)

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.

In summary, based on the previous studies in the literature, it is shown that integration of operations can improve order fulfilment in an organisation. However, little is known concerning the impact of SCI operational issues on order fulfilment in NZ public hospitals. 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.

3.4.4 Focused SCI

(See also section 2.8)

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."

In summary, the benefits of supply chain integration and their relationships to order fulfilment are discussed in the literature, but are not related to focused SCI (the new construct developed for this thesis). Therefore, this research assumes that focused SCI have positive impact on order fulfilment. The following hypothesis aims to fill the gap in the literature.

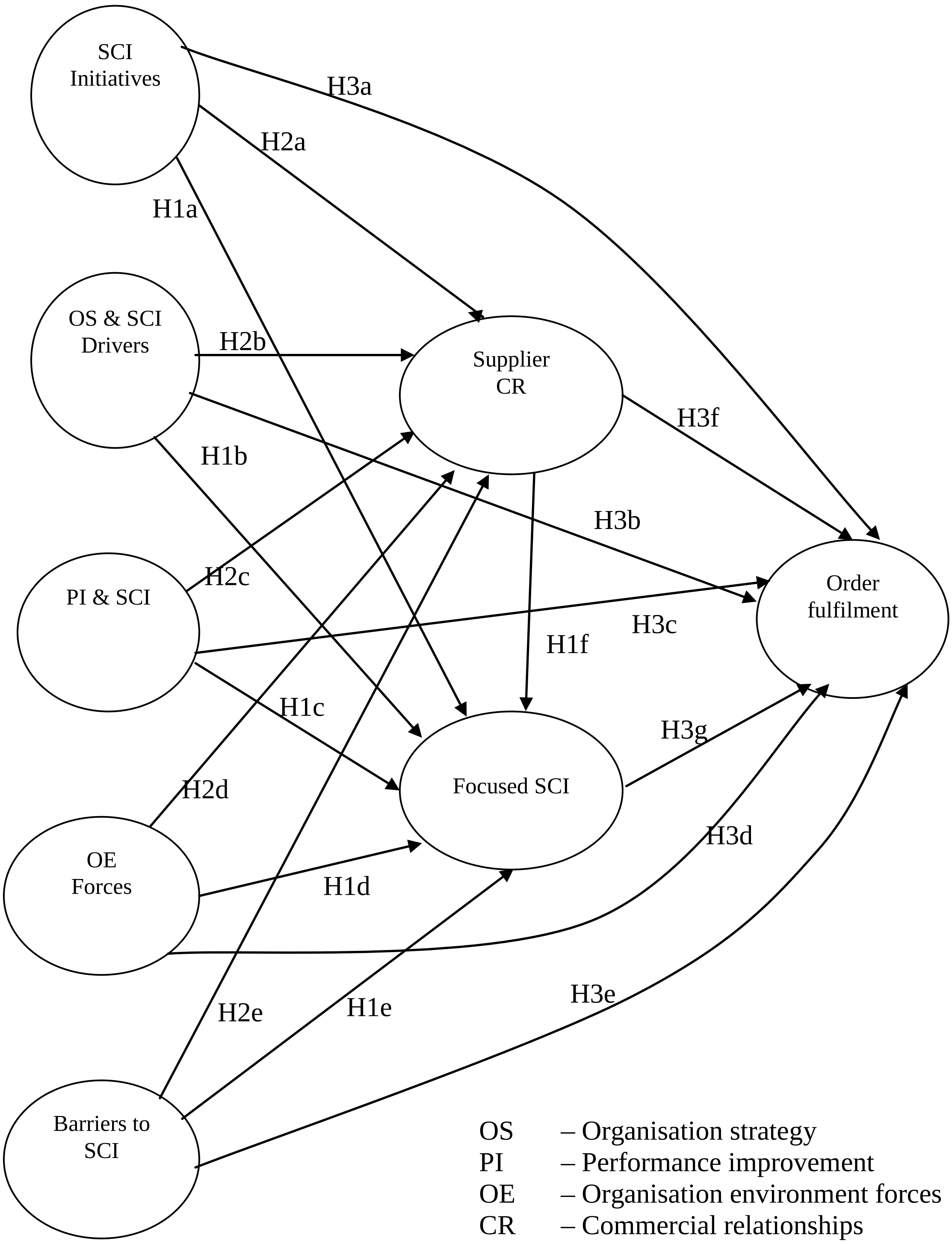
H3g: Focused supply chain integration has a positive influence on order fulfilment.

3.5 Conclusion

This chapter discussed the rationale for the theoretical model and hypothesized relationships in the model. The arguments presented in this chapter furnish the basis for the empirical study, design of the survey questionnaire, and the sample for this study covered in chapter four.
The hypotheses that have been developed in order to address the research questions for this study are indicated in **Figure 3.2** and summarised in **Tables 3.1a** and **3.1b.**

Figure 3.2: Research model hypotheses

SCI operational issues



OS – Organisation strategy
PI – Performance improvement
OE – Organisation environment forces
CR – Commercial relationships
SCI – Supply chain integration

Table 3.1a: 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 3.1b: 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.

CHAPTER 4.0 RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the methodological argument and the research procedure used in this research. The survey research approach (Fawler, 2002, Alreck & Settle, 2004) is used to study SCI operational issues (factors) in the NZ public hospitals and their impact on supplier commercial relationships and order fulfilment. This chapter is divided into the following twelve sections:

(1) Meaning of methodology
(2) An analysis of the research problems
(3) Philosophical position for this research
(4) Research paradigms
(5) Unit of analysis
(6) Selection criteria for the research method
(7) Development of survey questionnaire
(8) Development of the sample for the surveys
(9) Data collection process and analysis: (i) interview (ii) the pilot study (iii) the main study (iv) selection criteria for the analysis tool (see section 4.10.4), and
(10) Conclusion of this chapter.

4.2 Meaning of research methodology

Research is a process of enquiry and investigation, systematic and methodical, and it increases knowledge (Collis & Hussey, 2003). The research must be organised in order to obtain a reliable outcome, carried out systematically using suitable methods to collect data and analyse data, and also the research must address a specific problem (Collis & Hussey, 2003). Research methodology is the “entire process of the research study” (Collis & Hussey, 2003, p.17). A methodology is a model, which involves theoretical principles and a framework that furnishes guidelines about how research is conducted (Sarantakos, 2000).

It was necessary to determine an appropriate research process to study the existing problem.

4.3 Analysis of the problem

This research addresses the following major problem (see section 1.6 for other key research questions):

- What are potential critical operational factors that can influence the supply chain integration and their impact on supplier commercial relationships and order fulfilment in the NZ public hospital sector?

In order to solve the problem, it is essential to identify SCI operational issues, suppler commercial relationships, and order fulfilment factors. The overall objective of the 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. The main feature of this problem is complexity.

4.3.1 Complexity of identifying supply chain integration influences

The problem of supply chain integration is complex. Researchers, including Choi, Dooley, and Rungtusanatham (2001) have laid the groundwork for research in supply chain management and they model supply chains as “complex adaptive systems.” They argue that supply networks connected to many supply chains ultimately generate different products serving different and often hard-to-predict consumers (Choi et al., 2001). Furthermore, Bozart, Warsing and Flynn (2009, p. 80) define supply chain complexity as the “level of detail complexity and dynamic complexity exhibited by the products, processes and relationships that make up a supply chain.” Most researchers have paid attention to why it is important for organisations to enhance the scope and depth of their supply chain activities (e.g., Swafford, Ghosh, & Murthy, 2006). However, some researchers and practitioners have developed interest to examine the problem of expanding the scope and depth of supply chain activities (e.g., Hoole, 2006).

The nature of the research problem dictates its approach to solution (Tookey, 1998) (as cited in Shakantu, 2005, p.159), the methodological framework and methods of research. In addition, research methods are grounded in philosophical traditions that originate from the researcher's paradigm or basic set of beliefs that guides research (Gruba, 1990). The beliefs and philosophical traditions guide a researcher on how to obtain knowledge (Tookey, 1998). Therefore, it is important to determine the best philosophical position for the research.

4.4 Philosophical position for this research

When conducting a research it is necessary to obtain experiences from the informant's perspectives concerning the phenomenon, based on the philosophical assumption that "knowledge is the meanings people make of it; knowledge is gained through people talking about their meanings" (Creswell, 1998, p.19). It is important to understand philosophical issues that can help clarify alternative research designs and methods for a particular research (Easter by-Smith, Thorpe, & Lowe, 2002; Simatupang, Sandroto, & Lubis, 2004).

In order to determine the philosophical position for any research, it is considered essential to discuss the ontological and epistemological position (see sections 4.4.1 – 4.4.2). In addition, it is essential to integrate this research with the relevant research paradigm, which has implications on both research methodology and methods. The general approach to the research is a research paradigm (Collis & Hussey, 2003) (see section 4.4).

4.4.1 Ontological position

Ontological assumption is on the nature of reality. Ontology is an explicit specification of a shared conceptualisation, and it is a systematic account of existence (Gruber, 1993). The ontological assumption is that "you must decide whether you consider the world is objective and external to the researcher, or socially constructed and only understood by examining the perceptions of the human actors" (Collis & Hussey, 2003, p. 48). Morgan and Smircich (1980) refer to the positivist as the objectivists who assume that the social world is the same as the physical world. The ontological assumption is that reality is an external concrete structure which affects everyone. Collis and Hussey (2003) emphasise that the social world is external and real, the researcher can attempt to measure and analyse it using research methods such as laboratory experiments, and surveys. In addition, Morgan and Smircich (1980) refer to the phenomenologist as the subjectivist and their ontological assumption is that reality is a projection of human imagination. Thus, the reality is subjective.

4.4.2 Epistemological position

Epistemology is "concerned with the study of knowledge and what we accept as being valid knowledge" (Collis & Hussey, 2003, p. 48). The paradigm assumption is on the investigation of the relationship between the researcher and the researched. Different assumptions of social reality have different basis for knowledge of that reality. Different types of research paradigms have different epistemology stance. For example, the positivist paradigm (see section 4.5.1) has different assumptions of social reality and the epistemology (basis for knowledge) is that the researcher is independent. The phenomenological paradigm (see section 4.5.2) has different assumptions of social reality and the epistemology is that the researcher and researched interact in the research process.

This research adopted both a phenomenological epistemology stance for the pilot study, and a positivist epistemology stance for the main study in relation to the ontological assumptions discussed in section 4.4.1. The ontology assumption is concerned with the nature of reality and epistemology assumption is concerned with how the knowledge is created to understand the nature of reality (things). Therefore, the findings of this research depends on researcher's perspective of the reality and the relationship between the researcher, and the respondents in providing knowledge regarding supply chain integration operational issues, supplier commercial relationships and order fulfilment in NZ public hospitals.

4.4.3 Ontological and epistemological position

The ontological and epistemological stance for this research is that there is a social reality regarding SCI operational factors and their impact on supplier commercial relationships and order fulfilment, whether or not it can be observed and understood by the purchasing and supply chain personnel in the public hospitals. The use of objective view of positivist epistemology is important to identify and understand the SCI factors having impact on order fulfilment.

Social scientists have developed ontological paradigms to explain their own perspective of the world view under investigation. Each paradigm is linked to an epistemology that deals with how the world is perceived and the relationship between the researcher and the known view (Tower & Chen, 2008).

4.5 Research paradigms

Research paradigms assist a researcher to establish the type of methodology suitable for the study. Therefore, a selection of paradigm has consequences on the selection of research methodology. A paradigm is "the progress of scientific practice based on people's philosophies and assumptions about the world and the nature of knowledge" (Collis & Hussey, 2003, p. 352). A paradigm reflects peoples' primary assumptions concerning the world and the foundation of knowledge. Sarantakos (2000, p. 31) argues that a paradigm is a set of propositions that explain how the world is perceived, contains a world view, and a way of breaking down the complexity of the real world. Researchers need to determine methodological paradigms approach useful to their research. This research used two paradigms: positivist and phenomenological discussed in the following sections. Both paradigms were suitable to address the nature of the research problem.

4.5.1 Positivist paradigm

This study uses the positivist paradigm assumptions. The positivist paradigm is based on the assumption that:

> Social reality is independent of us and exists regardless of whether we are aware of it. Therefore, the ontological debate of ‘what is reality?’ Can be kept distinct from the epistemological question of ‘How do we obtain knowledge of that reality?’ The act of investing reality has no effect on that reality. According to positivist, laws provide the basis of explanation, permit the anticipation of phenomena, predict their occurrence, and therefore allow them to be controlled. Explanation consists of establishing causal relationships between the variables by establishing causal laws and linking them to a deductive or integrated theory (Collis & Hussey, 2003, pp. 52 – 53).

In general, the positivist research aims: to explain social life; predict course of events; and discover the laws of social life. Collis and Hussey (2003) provide the features of positivistic paradigm as follows: trends to produce quantitative data; uses large samples; concerned with hypothesis testing; data is highly specific and precise; the location is artificial; reliability is high; validity is low; and generalises from sample to population. “Positivism perceives social research in an instrumental way; research is a tool for studying social events and learning about them and their interconnections so that general causal laws can be discovered, explained and documented. Knowledge of events and social laws allows society to control events and to predict their occurrence” (Sarantakos, 2000, p. 38).

Assumptions about the nature of physical and social reality (ontology), together with assumptions about what constitutes valid knowledge (epistemology), influence what are considered acceptable methods for obtaining knowledge (methodology) (Doolin, 1996).

Positivist research is based on the assumption that there is a set of universal laws out there waiting to be discovered (Cavana & Sekaran, 2001). The advantage of positivist research is that it can identify the precise relationships between chosen variables. Using analytical techniques, the aim is to make generalizable statements applicable to real life situations (Chalmers, 1978). In order to obtain good research results, there is a need to use multiple sources of evidence (triangulation) and research strategies. Good research outputs can be realised by using better research strategies.

In addition, Sarantakos (2000, p. 37) emphasise that “there is no free will. The world is, however, not deterministic; causes produce effects under certain conditions, and predictions can be limited by the occurrence of such conditions”. This assertion supports Lambert, et al. (1998a) that the level of integration is situational and varies from one process link to another, and it is not advisable to manage all business process links.

4.5.2 Phenomenological paradigm

Phenomenology is the science of phenomena. A phenomenon is a fact or occurrence that appears or perceived. The phenomenological paradigm is concerned with understanding human behaviour from the participant’s own view. In response to the positivistic paradigm, the assumption is that social reality is within the human mind. Therefore the act of researching reality has an impact on that reality (Collis & Hussey, 2003). The ontology is that reality is subjective and the epistemology is that the researcher and researched interact in the research process. The emphasis is on the subjective situation of the individual. The key features of positivist and phenomenological paradigms identified by Easterby-Smith et al. (1991) are in Table 4.1.

Phenomenologists believe that social reality is dependent on the human mind. There is no reality independent of the human mind. Therefore what is investigated cannot be unaffected by the research process (Collis & Hussey, 2003). Naslund (2002, p.1) points out that “people view the world differently.” This has impact on the research process, in that both researchers’ selection of methodology and their approach to research is often and, or sometimes unnecessarily bound up with their paradigmatic preferences (Mangan et al., 2004).

Table 4.1: Key features of the positivist and phenomenological paradigms

	Positivist paradigm	Phenomenological paradigm
Basic Beliefs	The world is external and objective	The world is socially constructed and subjective
	Observer is independent	Observer is part of what is observed
	Science is value-free	Science is driven by human interests
Researcher should	Focus on facts	Focus on meanings
	Look for causality and fundamental laws	Try to understand what is happening
	Reduce phenomena to simplest events	Look at totality of each situation
	Formulate hypotheses and then test them	Develop ideas through induction from data
Preferred methods include	Operationalising concepts so that they can be measured	Using multiple methods to establish different views of phenomena
	Taking large samples	Small samples investigated in-depth or over time

Source: Easterby-Smith et al., 1991

4.5.3 Mixed approaches

The sections 4.5.1 and 4.5.2 show that both positivist and phenomenological paradigms provide different functions and perspectives in conducting research. Tookey (1998) stresses the need for a researcher to design carefully the research problem, because the nature of the problem determines the means to solution (as cited in Shakantu, 2005, p.159). The dominant paradigm in business research is the positivistic paradigm. However, phenomenological or qualitative approach is becoming more acceptable in many business studies (Collis & Hussey, 2003). This research used a phenomenological stance using in-depth interviews to determine insights of the SCI phenomenon in the public hospitals. The positivist stance was used to conduct surveys for the pilot study and the main study. There are many debates on the use of positivism and phenomenology paradigms in the social sciences. But depending on the nature of the study, both approaches have advantages and disadvantages covered widely in the literature.

The problem for investigation in this research is an objective problem, which requires the phenomenon to be observed, measured, and test hypotheses. Therefore, the suitable research approach must be positivist. The expected output of this research is determining the SCI operational factors and their impact on supplier commercial relationships and order fulfilment (see section 4.3) need to be generalised. It is important to use a positivist philosophical position for the research process in order to achieve the research objectives (see section 4.5.1).

4.6 Unit of analysis

As indicated in Chapter one, the unit of analysis for this study is supply chain Integration (SCI) influences. There are four different levels of SCI. Firstly, the SCI of operational issues, secondly, supplier commercial relationships, thirdly, order fulfilment, and fourthly, the focused SCI. This study investigated the nature of SCI as perceived by the purchasing and supply personnel in the public hospitals in NZ.

In addition, key informants in the public hospitals might occupy different positions, and had varied perspectives concerning SCI in their hospitals. The appropriate informants were the personnel directly involved with the activities of purchasing and supply who had necessary knowledge to complete the survey questionnaire. The primary respondents for this study were public hospital's purchasing and supply managers, materials managers, and purchasing coordinators.

4.7 Selection criteria for the research method

A research method is a technique for collecting and /or analysing data (Collis & Hussey, 2009). Survey research approach was 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 (Hair et al., 2006). In a positivist research, a survey approach is intended to gather primary data from a sample, with a view to analysing them statistically and generalising the results to a population (Collis & Hussey, 2009). The two main methods used in this research are survey questionnaire and interviews designed to collect information on the nature of the problem in this positivist study.

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 to solve an existing problem.

The selection of research approach (quantitative and /or qualitative) depends on the nature of the phenomenon and the type of research questions. Since the SCI operational issues, supplier commercial relationships, and order fulfilment phenomena in NZ public hospitals is not known, it was necessary to develop an understanding of the new phenomena using a qualitative approach. Interviews were used to collect data. The differences between the quantitative and qualitative research are provided by Murphy (1997, p.18) in Table 4.1.

Table 4.2: Quantitative versus qualitative research

	Quantitative Research	Qualitative Research
Objective	To quantify the data and generalize the results from the sample to the population of interest	To gain a qualitative understanding of the underlying reasons and motivations
Sample	Large number of representative cases	Small number of representative cases
Data collection	Structured	Unstructured
Data Analysis	Statistical	Nonstatistical
Outcome	Recommend a final course of action	Develop an initial understanding

Source: Murphy (1997, p. 18).

The quantitative approach using a survey questionnaire was used to collect data on the variables on the phenomena identified in the literature and the interviews. Creswell (1998) argues that research questions designed at explaining relationships among variables by examining variation are ideal for the quantitative approach. This research has key research questions (see section 1.6) which aimed to determine the relationships between variables of SCI operational issues, supplier commercial relationships, focused SCI, and order fulfilment. Additionally the conceptual research model (Figure 3.1) shows relationships between variables. The quantitative research approach was appropriate for this research because the objective of the thesis was to explore causal relationships among the variables, and it was compatible with the research paradigm.

In order to ensure the validity of the respondents' results of the investigation, it was important that all informants understand the definition of SCI provided by the National Research Council in the U.S. (2000) in the context of this study. Therefore, both survey questionnaires for the pilot and main studies had a definition of SCI (see appendices B and D).

4.7.1 Framework of study

Figure 4.1 shows the framework of methodology for this study. The framework has four main sections: questionnaire development, data collection: pilot study, data collection: main study, and data analysis using a triangulation of techniques. The following sections 4.10 – 4.12.4 discuss the framework of methodology.

4.8 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 (see chapter 3). In addition, preliminary interviews with senior purchasing and supply executives were carried out, and provided additional scale items related to the operations of the public hospitals. SCI operational issues (factors) from Fawcett and Magnan (2001) were adopted, as 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 step-by-step procedure in the development of the survey questionnaire is illustrated in Figure 4.1, and the steps proposed by Churchill in development of a survey questionnaire are presented in Figure 4.2.

Multi-item scales were used to measure every construct in the research model (chapter 3). A 5 - point Likert scale from “strongly disagree” to “strongly agree” was used in the questionnaire for most questions.

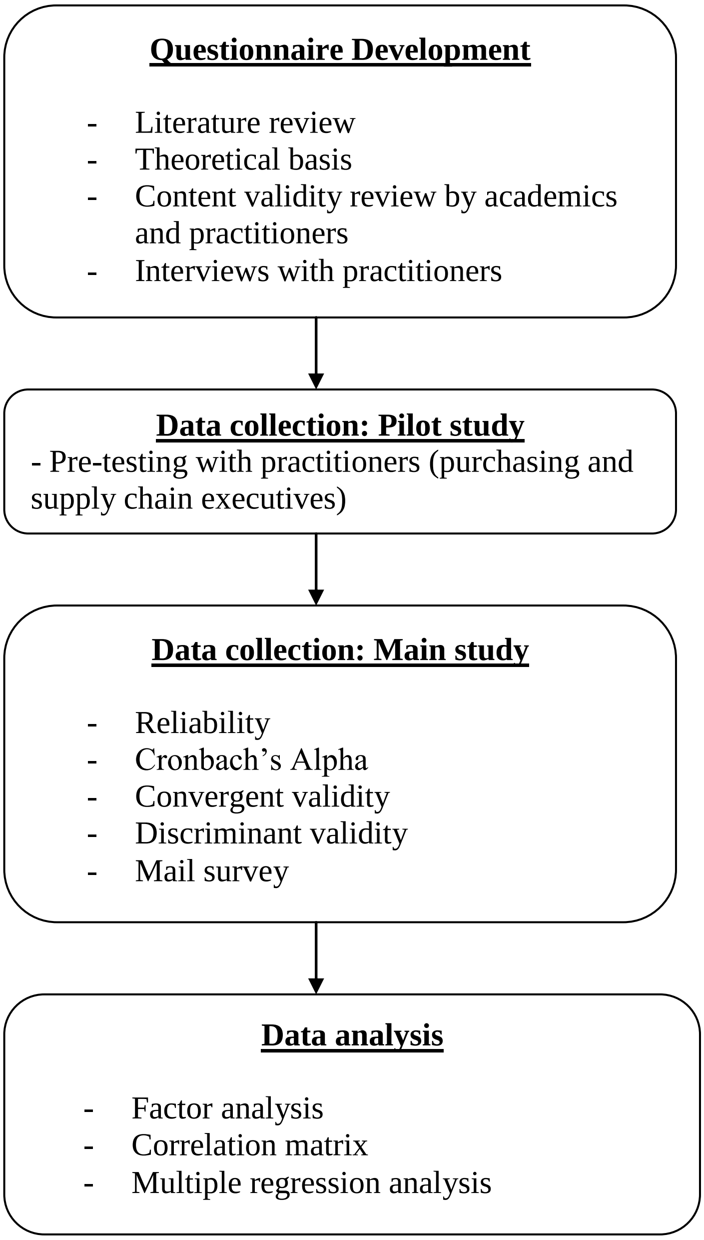


Figure 4.1: Framework of methodology

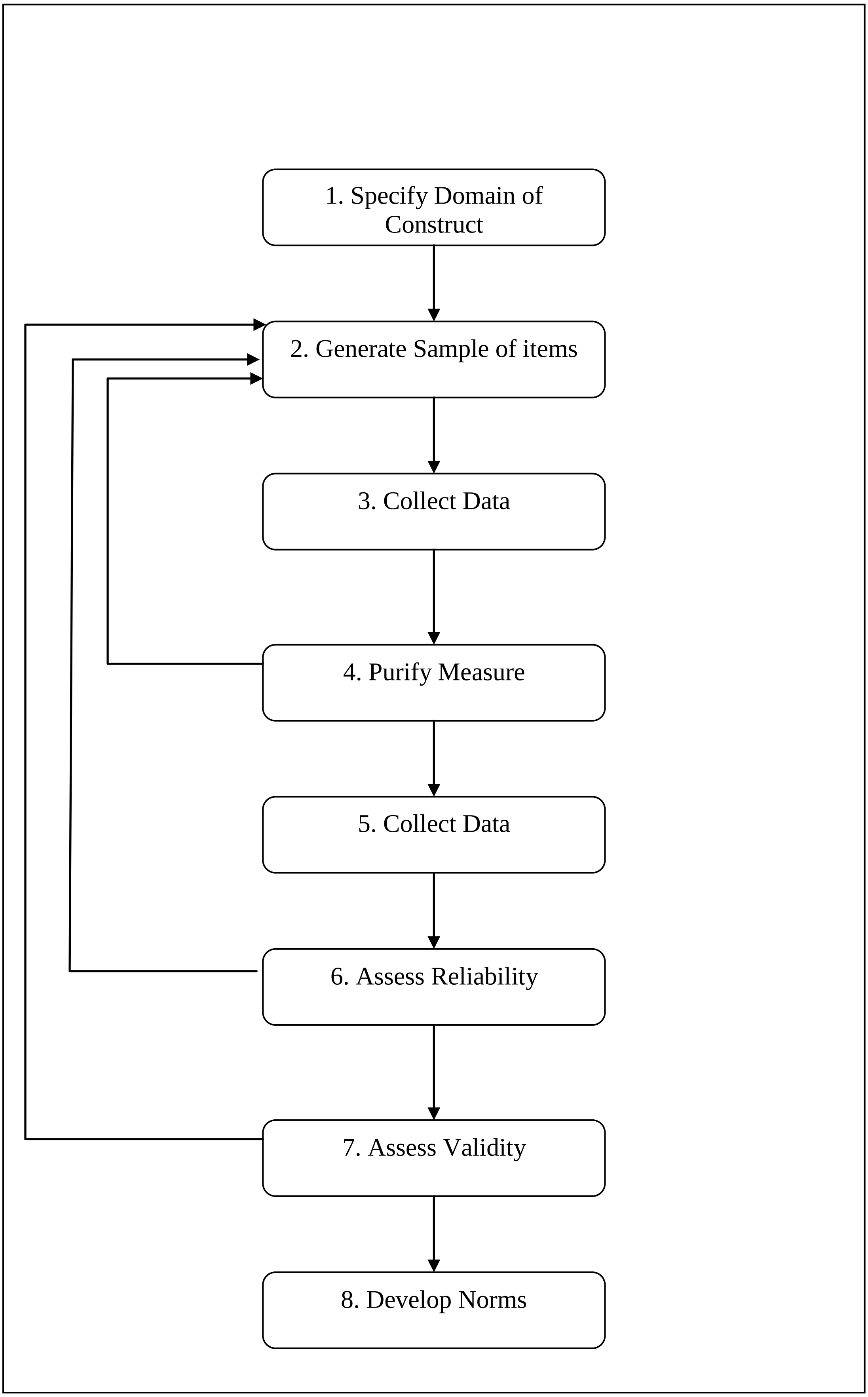


Figure 4.2: Churchill's Paradigm

The first step in Figure 4.2 for specification of constructs domains has been discussed in chapter three. Therefore, this chapter starts with step 2, where questionnaire items are generated from the literature and past research studies.

The initial survey questionnaire was reviewed by academics and practitioners in purchasing and supply area for content, clarity, and ease of understanding. The review was conducted by three academics, two being the research supervisors and an academic from another institution. In addition, two senior purchasing and supply executives in public hospitals carried out the review of the survey.

The survey questionnaire was revised after considering review comments from the academics and the 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 contained items generated from the literature review.

The modified survey questionnaire had multiple items, which were used to determine whether there was internal consistence, discriminant, and convergent validity. After developing the survey questionnaire, a pilot study was conducted. The pilot study is discussed in Section 4.10.2.

4.8.1 Measurement of constructs and scale development

The empirical study that was conducted to test the theoretical model and hypothesized relationships was based on a survey questionnaire completed by the purchasing and supply personnel in the public hospitals.

The steps used in designing and validating the survey, are discussed in the following sections. The initial step in designing the survey was to generate a comprehensive list of measurement items and survey questions from the literature that were used in previous studies on each construct, and from the interviews. The measurement items concerning the SCI operational issues were mainly 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. The questions that were used in the initial survey (pilot study) are indicated in Appendix B1. The measurement items generated for this study are indicated in Tables 4.3 – 4.10.

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 item pool generated for the construct of SCI initiatives are indicated in Table 4.3.

Table 4.3: Measurement items for the construct SCI initiatives

Construct	**Measurement item**	**Source**
SCI initiatives	V1.Cross-functional process integration within the hospital V2.Integration with valued first-tier customers V3.Integration with important first-tier suppliers V4.Complete customers and suppliers supply chain integration.	Fawcett and Magnan (2001)

The item pool generated for construct organisational strategy and SCI drivers are indicated in Table 4.4.

Table 4.4: Measurement items for the construct organisation strategy and SCI drivers

Construct	Measurement item	Source
Organisation strategy and SCI drivers	V5. Our organisation's corporate strategy includes supply chain integration V6.We have a centralised purchasing department V7. Our organisation promotes integration through use of information technology V8. Lowering costs is a core driver of our supply chain integration V9. Improving service level is another core driver influencing our supply chain integration in our hospital.	Interviews

The item pool generated for construct performance improvement and SCI are indicated in Table 4.5.

Table 4.5: Measurement items for the construct performance improvement and SCI

Construct	Measurement item	Source
Performance improvement and SCI	V10.Ability to handle expected challenges V11.Lowering cost of purchased items V12.Hospital profitability V13.Inventory costs V14.On-time delivery/Due-date performance V15.Order fulfilment lead times V16.Overall customer satisfaction V17.Overall product cost V18.Overall product quality V19.Total productivity V20.Responsiveness to customer requests V21.Transportation costs V22.Planned requirements from customers	Fawcett and Magnan (2001)

The item pool generated for construct organisation environmental forces are indicated in Table 4.6.

Table 4.6: Measurement items for the construct organisation environmental forces

Construct	Measurement item	Source
Organisation environmental forces	V23.Suppliers have initiated integration effort V24.Customers have initiated integration efforts V25.Desire to improve customer satisfaction V26.Desire to lower supply chain costs V27.Desire to focus on core competence in services V28.Opportunity to build the best team of supply chain partners	Fawcett and Magnan (2001)

The item pool generated for construct barriers to SCI are indicated in Table 4.7.

Table 4.7: Measurement items for the construct barriers to SCI

Construct	Measurement item	Source
Barriers to SCI	V29.A lack of willingness to share information V30.Difficult to establish relationships based on shared risks and rewards V31.Difficulty to evaluate contribution of each supply chain member V32.Inappropriate information systems V33.Inconsistent operating goals V34.Lack of clear guidelines for managing supply chain alliances V35.Lack of employee loyalty, motivation, and empowerment	Fawcett and Magnan (2001)

	V36.No systematic approach to measuring customer requirements V37.Lack of good performance measures V38.Organisational boundaries prevent integration V39.Value-added processes are not accurately costed V40.Budget limitation for supply chain resources V41.Lack of suppliers to comply with agreed key performance indicators (KPIs) V42.Government procurement policies and procedures	Interviews Interviews Interviews Interviews Interviews

The construct supplier commercial relationship was defined in chapter 3. The items that have been developed for this study are from the interviews and past general literature on supplier relationships. The items are indicated in Table 4.8.

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.

Table 4.8: Measurement items for the construct supplier commercial relationships

Construct	Measurement item	Source
Supplier commercial relationships	V43.We have reliable suppliers V44.We promote partnership with dedicated suppliers V45.We have good process integration between suppliers, customers, and the District Health Board (DHB) V46.We have joint or collaborative planning V47.We make effective negotiations with suppliers V48.We have good level of trust in buyer supplier relationships V49.Quality of information shared is good V50.We have increased level of strategic alliance with suppliers V51.We have good communication with suppliers V52.Power of the supplier has impact on relationship V53.Our suppliers prefer electronic purchasing V54.We have supplier development programme V55.We value importance of measuring relationship V56.We use KPIs in judging our suppliers V57.We have a service level agreement V58.We have continuous improvement programmes V59.We have good relationship / trust with our third party buyer V60.We use a contract to maintain relationship V61.We have single source relationships	Literature review and interviews

Focused supply chain integration was defined in chapter three, and it is composed of behavioural factors for this study. The items that were developed from the interviews with purchasing and supply executives are indicated in Table 4.9.

Table 4.9: Measurement items for the construct focused SCI

Construct	Measurement item	Source
Focused SCI	V62.Our service functions are integrated V63.We follow national procurement policies and procedures V64.We use an Enterprise Resource Planning (ERP) system e.g., SAP, Oracle, JD Edwards V65.We use an ERP system for health sector V66.We give high priority to consultation with other departments V67.We have a national supply chain integration policy V68.We have good service integration V69.We have good networking and build with suppliers V70.Top management is committed to supply chain integration processes V71.We have good organisational culture that supports supply chain integration V72.We value supply chain management V73. Our organisation structure is good for internal supply chain integration	Interviews

The construct order fulfilment was defined in section 3.3.4. The dependent order fulfilment construct represents a set of measurements / variables which can have effect on order fulfilment. The items that were developed for this study are from the interviews and past general literature on order fulfilment.

Interviews generated important issues affecting order fulfilment in public hospitals. The items are indicated in Table 4.10.

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.

Table 4.10: Measurement items for the construct order fulfilment

Construct	Measurement item	Source
Order fulfilment	V74.We classify inventories according to their importance V75.We have collaborative planning, forecasting and replenishment (CPFR) V76.We make an effort to control ordering costs V77.Suppliers have capacity to meet the demand V78.We have capacity to respond to demand V79.We have reduced order fulfilment lead time V80.We have an inventory policy of maintaining high level of inventory for critical items only V81.We have an inventory policy for important items V82.We have inventory policy for all items V83.We have supplier – buyer integrated order Planning V84.Suppliers (vendors) manage our inventory V85.Our deliveries from suppliers are on time and right quantity V86.We emphasize to suppliers that accuracy and efficiency of order fulfilment is important V87.We improve supplier performance using order fulfilment metrics (measures)	Literature review and interviews

	V88.We have a high stockturn (products are not spending a long time in storage) V89.We do maintain high levels of emergency supplies	

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

4.8.1.1 Scale Validation

Apart from the open ended questions (type of system support, how can a public hospital in NZ enhance supply chain integration, rating of supplier selection factors, ranking of criteria in selecting suppliers, and general information), a scale ranging from 1 to 5 was used to give respondents a suitable range in their assessments. Although the literature mainly supports the use of a large range in the Likert scale (e.g., 1 – 7), Gupta and Somers (1992) argue that respondents will not be able to differentiate the differences in a range of scales beyond 5. Cavana, Delahaye, and Sekaran (2001, p. 206) state "research indicates that a five – point scale is as good as any, and that an increase from five to seven or nine points on a rating scale does not improve the reliability of ratings."

The response categories for the scales range from 'strongly agree' for the nature of supply chain in the hospital, supplier commercial relationships, order fulfilment, and focused supply chain integration. The range is from 'not engaged' to 'totally engaged' for supply chain integration initiatives. The range is from 'not improved' to 'greatly improved' for supply chain performance improvement. The range is from 'not a factor' to 'critical factor' for importance of environmental factors. Finally, the response category for the scales range from 'not a barrier' to 'serious barrier' for barriers to supply chain integration in the hospital.

In order to minimize response bias, it was necessary to reverse some items, especially the items influenced by positive or negative responses (Alreck & Settle 1985). As sometimes respondents show a positive response to all items in scale, Schmitt and Klimoski (1991) suggest that some items must have positive or negative responses to minimize response bias. For example, a five point Likert scale was used with the scale range from 1 (strongly disagree) to 5 (strongly agree).

Initial validation of the item measures was achieved during initial development of the survey. The initial development of the survey questionnaire was based on an interview with a key person in charge of purchasing and supply in a public hospital. Then further interviews were conducted separately with two key purchasing and personnel in two public hospitals. The interviews lasted for one hour. One senior and one lower level purchasing and supply personnel were interviewed in order to minimize (or remove) status bias (Heiskanen & Newman, 1997). The interviews were conducted using the interview questionnaire, and also the participants were asked to contribute additional measures they thought were important in the survey.

The contact was made to the NZDHBs Coordinator regarding this project, and the Coordinator provided necessary support by providing a mailing list of key purchasing and supply managers in the DHBs. The mailing list was used for pre-testing and pilot testing. Public hospitals were contacted directly using addresses from the Ministry of Health and the DHBs websites.

The next step was to revise/edit the survey questionnaire for the pilot study. The sample for the pilot study was selected randomly from purchasing and supply personnel in public hospitals.

During the pilot study, 150 respondents were asked to complete the survey. Only 12 completed the survey, with a response rate of 8%. SPSS factor analysis was used for the exploratory study, but few constructs met the conditions for valid factor analysis. The sample size is very small for rigorous statistical testing. Therefore, the analysis was limited to the descriptive statistics. The pilot study is discussed in Section 4.10.2.
Final validation of the scales was achieved by conducting a large scale study with a sample size of 350 purchasing and supply personnel in public hospitals. Multiple items/questions were identified for each latent variable to achieve a high level of reliability, discriminant, and convergent validity.

Reliability refers to the "measure of the degree to which a set of indicators of highly reliable constructs are highly interrelated, indicating that they all seem to measure the same thing. Individual item reliability can be computed as 1.0 minus the measurement error" (Hair et al., 2006, p. 710). In classical testing, reliability is defined as the ratio of the true to the observed variance, and the higher the ratio, the greater the reliability of the measure (Carmines & Zeller, 1979). However, Hair, et al. (2006) state that high reliability doesn't guarantee that a construct is representing what it is supposed to represent though it is a necessary condition for validity.

The internal consistency method is one of the most used reliability measure that estimates the reliability of a construct. The most popular measure of reliability is that proposed by Cronbach (1951) (Carmines & Zeller, 1979). Cronbach's alpha is used to determine each construct's reliability. Values of more than 0.70 are normally considered to be acceptable for the scales. The values greater than or equal to 0.60 are used for newly developed scales (Nunnally, 1978).

Convergent validity is tested by determining whether items in a scale converge or load together in a single construct (Garver & Mentzer, 1999). Convergent validity is measured by examining the individual scale item loadings on the construct they are required to measure. Hair et al. (2006, p. 137) define convergent validity as "the degree to which two measures of the same concept are correlated."

Discriminant validity is determined by showing that the measure does not correlate highly with another measure from which it should differ (Campbell 1960). Furthermore, Hair et al. (2006, p. 137) define discriminant validity as "the degree to which two conceptually similar concepts are distinct." Two methods of discriminant validity were used in this thesis. The first method considers the estimated correlations between the factors not greater than 0.85 and the items that indicate a lack of discriminant validity are deleted (Kline, 2005). The correlation matrix was used for discriminant validity. The second method used to assess discriminant validity considers pattern structure coefficient to determine whether factors in measurement models are empirically distinguishable (Thomson, 1997). Pattern coefficient is the standardized factor loading obtained from multiple regression analysis. Results related to construct validity are discussed in chapter five.

4.9 Development of sample for the surveys

This study applied a survey research approach for data collection. The purposeful sampling, a non-probability sampling was used for the interviews (see section 4.12.1), a pilot study (see section 4.12.2), and the main study (4.12.3). Purposeful sampling means that the ’’researchers intentionally select participants who have experience with the central phenomenon or the key concept being explored’’ (Creswell & Clark, 2007, p.112). In this sampling strategy, the researchers purposely select ‘’subjects select who, in their opinion, ate thought to be relevant to the research topic’’ (Sarantakos, 2000, p. 152). Therefore, purposive sampling was suitable for this research because purchasing and supply personnel offered valid and useful information on SCI operational issues, supplier commercial relationships, and order fulfilment in NZ public hospitals.

The population for the survey was 40 public hospitals and 21 DHBs with 350 purchasing and supply personnel directly involved in purchasing goods and services for the public hospitals. A mailing list of purchasing and supply managers was obtained from the New Zealand District Health Boards (NZDHBs), and the managers had a list of their subordinates. Contacts were made using blind copies of e-mails to maintain confidentiality. Postal addresses were obtained from the Ministry of Health website which provides the DHBs’ and public hospitals’ addresses.

4.10 Data collection process and analysis

4.10.1 Interview

In order to gather information necessary for developing and/or improving the survey questionnaire (first developed using the information from the literature review), it was important to interview the purchasing and supply chain executives in the public hospitals. Initially, seven purchasing and supply executives were invited to participate in the study, but only two respondents (28.6% response rate) accepted to be interviewed. It was fortunate that the executives who agreed to participate in the study composed of a senior and a lower purchasing and supply manager, which reduced bias in responses. Interviewing only people of high status (key informants) can result in lack of understanding of the broader picture of the existing situation and can create elite bias. Miles and Huberman (1994) discuss the bias introduced in qualitative research by interviewing the stars in an organisation. In addition, Heiskanen and Newman (1997) state that elite bias concerns overweighting data from high-status informants and under-representing data from lower-status ones.

The questionnaires were e-mailed to all participating purchasing and supply executives before the interview to enable them to prepare answers in advance. This practice shortened the time required for interviews. It was easy for the respondent to follow the questionnaire during the interview. All the interviews were completed between one and two hours, and there was no evidence of either interviewer or respondent fatigue. Interviewees appeared to enjoy the interview, because the study centres on crucial issues related to the purchasing and supply operations in the public hospitals in NZ.

The interviewer followed the guidelines provided by Fowler (2002, p. 117 -118) regarding three primary roles to play in the collection of survey data:

- To locate and enlist the cooperation of selected respondents
- To train and motivate respondents to do a good job of being a respondent.

For example, interviewers who read the questions slowly to respondents, in a nonverbal way, their willingness to take the time to obtain thoughtful, accurate answers; consequently, they do obtain more accurate answers.

- To ask questions, record answers, and probe incomplete answers to ensure that answers meet the question objectives.

Furthermore, interviewees were asked to add some measures on the survey questionnaire that they considered important in the pilot survey. Also, the interviewees were asked to comment on the clarity and understanding of the questions in the survey questionnaire. The response was that the questionnaire was clear and easy to understand.

In addition, in order to make sure that interview procedures were properly followed and reduce interview bias, only one interviewer conducted the interviews.

The literature review and the two in-depth interviews with purchasing and supply executives led to the identification of the scale items for the pilot mail survey questionnaire.

4.10.2 Pilot study

Many researchers have suggested the use of different combinations of the pre-test or pilot study methods (e.g., Blair & Presser, 1992; Malhotra, 2003; Churchill, 1995). The pre-test methods used in this thesis are interviews, expert input (academics), and the survey.

The pilot study was divided into two parts. First, interviews with the purchasing and supply executives and used the result to improve the questionnaire and the hypotheses generated from the literature. In addition, purchasing and supply executives, and academics advised on the clarity of the instructions and validity of the questionnaire. Eighty nine items were developed to measure eight constructs of the conceptual model (Appendix B) for the pilot study. Secondly, the survey was sent to 150 purchasing and supply personnel in the DHBs and public hospitals. Only the procurement (purchasing and supply) managers and procurement specialists were selected for the pilot study. A reminder e-mail was sent to the potential respondents (procurement managers and chief finance officers), 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 (all up total of 15 or 10% response rate).The sample was too small for rigorous statistical testing, but the responses were sufficient to determine useful questions for the main survey.

The following section discusses the results of the pilot study.

4.10.2.1 Results of the pilot study

Out of 15 responses received, 12 were usable (8% response rate). Three questionnaires were not completed due to outsourcing of the procurement function in the hospitals, and the respondents were new to the hospitals. The low response rate was assumed to be due to the length of the questionnaire and that purchasing and supply executives were engaged in another survey.

The usable 12 responses were used to analyse the survey. Appendix C1 indicates the results of the factor analysis using extraction method: principal component analysis and the internal consistency reliability of scales using Cronbach’s alpha for each construct used in this pilot study research.

The measurement items with less than one initial eigenvalue were included in the main study for valid factor analysis.

4.10.2.2 Survey questionnaire revisions of the pilot study.

The Cronbach’s alpha analysis for the constructs in the pilot study indicated that the constructs had Cronbach’s alpha values between 0.752 and 0.897. Values of greater than 0.70 are considered to be reliable (Nunnally, 1978). The generally accepted lower limit for Cronbach’s alpha is 0.70 (Hair, Black, Babin, Anderson, & Tatham, 2006; Robinson, Shaver, & Wrightsman, 1991). Since the sample size was too small to perform factor analysis for most constructs, it was necessary to use a combination (triangulation) of methods, such as the factor analysis using the extraction method: principal component analysis (eigenvalues), factor loading, and mean values with standard deviations in order to determine the measurement items for the main study. The measurement items with high eigenvalues, high mean, and low standard deviation were included in the main study. The results are in the Appendices C1, C2, and C3. Fifty five items were developed to measure eight constructs of the theoretical model for the main study (Appendix D). Most measurement items were retained for the main study because of the small pilot study sample size (Van Hoek, 2001; Van Hoek, Harrison, & Christopher, 2001).

4.10.2.3 Non response bias

The non-response bias was assessed by grouping responses into two equal groups: early responses and late responses (Amstrong & Overton, 1977) for mail survey, using a two-sample t-test for all 89 variables of the 8 constructs (Tables 4.11 and 4.12).

Table 4.11: Groups' early and late responses

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
RESPONSE	Early	534	3.2116	1.0708	4.63E-02
	Late	534	3.3764	1.0866	4.70E-02

Table 4.12: Levene's test and t-test

Independent Samples Test

	Levene's test for equality of Variances		T-test for equality of means		
	F	Sig.	T	df	Sig. (2-tailed)
Equal variances assumed	0.003	0.956	-2.496	1066	0.013

The mean for group 1 (early respondents) (mean = 3.2116, standard deviation = 1.0708) was lower than group 2 (late respondents) (mean = 3.3764, standard deviation = 1.0866). The negative t value indicates that the mean amount of late responses in group 2 is not significantly greater than the mean for the early responses in group 1, $t(1066) = -2.496$, $p < 0.05$. 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 pilot study.

4.10.3 Main study

The main study was conducted using a revised survey questionnaire which was sent to population of 350 purchasing and supply personnel in 21 DHBs plus 40 public hospitals.

The main contact was through the managers in charge of purchasing and supply in each DHB selected from the NZDHBs mailing 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, questionnaires were sent to 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 envelope.

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 could remind their subordinates 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 response rate was better than the previous study on supply chain management practices in New Zealand conducted by Basnet et al. (2003). They sent a survey questionnaire to 627 potential respondents and finally received 69 usable responses (response rate of 11.0%). The characteristics of the DHBs which responded to the survey are indicated in Table 4.13.

Table 4.13: The profile of the respondents 21 DHBs (which own 40 public hospitals) indicating group data for the year ended 30 June 2008.

Item	Range ($000s)	Frequency	(%)
Total income:	Less than $500,000	14	67
	501,000 – 1,000,000	3	14
	Over 1,000,000	4	19
	Total	**21**	**100**
Net surplus:	Less than $60	1	5
	61 - 100	0	0
	101 - 1000	1	5
	1001 - 3000	1	5
	Over 3000	4	19
Net deficit:	Less than $ 1000	1	5
	1001 - 2000	2	9
	2001 - 4000	3	14
	4001 - 10000	5	24
	Over 10000	3	14
	Total	**21**	**100**
Inventories:	Less than $1000	4	19
	1001 - 2000	5	24
	2001 - 3000	6	29
	3001 - 4000	1	5
	4001 - 6000	2	9
	Over 6000	3	14
	Total	**21**	**100**

Source: Data extracted from Annual Reports (DHBs websites)

4.10.3.1 Non response Bias

One potential problem with a survey methodology is the existence of non response bias (Lambert & Harrington, 1990). To evaluate the possibility of non-response bias, a formal procedure was used to compare early respondents with late respondents, as suggested by Armstrong and Overton (1977). The underlying assumption is that late respondents are more likely to answer the questionnaire with less thought compared to the early respondents.

The non response bias was assessed by grouping responses into two groups: early responses and late responses, according to Armstrong and Overton (1977). The results of t-test for selected five constructs (with 31 variables) of 10 early responses and 10 late responses are indicated in Tables 4.14 and 4.15.

Table 4.14: Groups' early and late responses

Group Statistics

	group	N	Mean	Std. Deviation	Std. Error Mean
Response	1.00	310	3.6742	.94525	.05369
	2.00	310	3.6871	.66500	.03777

Table 4.15: Levene's test and t-test

Independent Samples Test

	Levene's test for equality of Variances		T-test for equality of means		
	F	Sig.	T	df	Sig. (2-tailed)
Equal variances assumed	50.658	0.000	-.197	618	0.844

The mean for group 1 (early respondents) (mean = 3.6742, standard deviation = 0.94525) was lower than group 2 (late respondents) (mean = 3.6871, standard deviation = 0.665). The negative t value indicates that the mean amount of late responses in group 2 is not significantly greater than the mean for the early responses in group 1, $t(618) = -0.197$, $p > 0.05$. 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.

4.10.4 Selection criteria for the data analysis techniques

The responses from the interviews were analysed using cross-case analysis (Yin, 2003) to identify factors influencing SCI, supplier commercial relationships and order fulfilment in the public hospitals. The cross-case analysis is good for aggregating findings across a series of individual studies (Yin, 2003), and it was appropriate to identify variables for developing hypotheses, the research model, items for the survey, and also to answer the question on the ways to enhance SCI in public hospitals.

4.10.4.1 Triangulation of techniques

Triangulation is the use of multiple research approaches, methods, and techniques in the same study in order to reduce bias (Collis & Hussey, 2003). The data collected from the survey were analysed using a triangulation of techniques as follows: factor analysis (for exploratory analysis), correlation matrix of the measures, and multiple regression analysis using SPSS software package version 17 (see section 4.12.4.3). Structural equation modelling (SEM) (for confirmatory analysis) and the structural model (path analysis) were not conducted due to the small sample size.

4.10.4.2 Structural equation modelling

The structural equation modelling is considered sound as: (1) it provides a straightforward method of dealing with multiple relationships simultaneously while providing statistical efficiency, and (2) its ability to assess the relationships comprehensively and provide a transition from exploratory to confirmatory analysis (Hair, Black, Babin, Anderson, & Tatham, 2006). Shah and Goldstein (2006) found that SEM is a valuable and widely used tool for testing and advancing operations management issues and research.

The structural equation modelling technique using Partial Least Squares (PLS) has ability to provide good results when sample sizes are small (Chin, 1995; Gefen, Straub, & Boudreau, 2000). But, PLS doesn’t use fit indices like other SEM software (e.g., AMOS). Some of the disadvantages of PLS are: lacks of assessment of unidimensionality, parameter estimates are not as efficient as that of AMOS, and there is no overall test of model fit (Anderson & Gerbing, 1988; Fornell & Bookstein, 1982). However, recent studies conducted by Goodhue, Lewis, and Thomson (2006); Marcoulides and Saunders (2006); Hsu, Chen, and Hsieh (2006); and Rouse and Corbit (2008) revealed that PLS as do other SEM tools, such as AMOS require relatively large samples to produce good results. They do not support the findings of Gefen et al. (2000) and Chin (1995, 1998) who claim that large samples are not essential for PLS. Furthermore, Hair et al. (2006) caution on the use of PLS regression as a SEM tool.

Bentler and Chou (1987) suggest that researchers may go as low as five cases per parameter as long as the data is normally distributed, no missing data or outlying cases, etc. Loehlin (1992, 2004) conducted Monte Carlo models and concluded that the model with two to four factors, a minimum sample size of 100 to 200 cases is better. However, Allison and Allison (1999) argue that small samples (under around 100 to 120 responses depending on the variance) are largely inadequate for testing theory. There is disagreement in the literature regarding the minimum sample size for confirmatory factor analysis. According to Hair et al. (2006) a minimum sample size of 50 provides valid results using SEM maximum likelihood estimation (MLE) procedure. They recommend minimum sample sizes within the range from 100 to 150 to guarantee stable MLE (Hair et al., 2006).

4.10.4.3 Factor analysis, correlation matrix, and multiple regression analysis

Due to problems of getting high responses from the DHBs and public hospitals, this research, with 60 responses for the main study survey meets only the minimum requirement of five cases per parameter (Bentler & Chou, 1987). The 60 usable questionnaires all have values for the items of the constructs of the theoretical model (i.e., there are no missing values), and satisfy the minimum condition for use of factor analysis for each construct (e.g., five responses for each variable). The sample size is not ideal for structural equation modelling (SEM). As the number of independent variables in each construct is between 2 and 4, multiple regression was used for data analysis. The minimum requirement (only one construct has 4 independent variables) for a sample of 60 responses was achieved. "Although the minimum ratio is 5:1, the desired level is between 15 to 20 observations for each independent variable. When this level is reached, the results should be generalizable" (Hair et al., 2006, p. 196). The sample of 60 usable responses also meets the minimum requirement of 15 observations per independent variable according to Hair, et al. (2006). The correlation matrix of the measures was used to determine the relationships between variables. The triangulation of techniques helped to gain more insights on the relationships between the variables used in this research.

The literature shows other research surveys that used small sample size similar to this research and used multiple regression analysis. For example, Simpson, Power, and Samson (2007) had 56 usable surveys (out of 400 surveys distributed) for linear regression analysis; Rao (2002) used a sample of only 52. Hair et al. (2006) recommends a minimum number of 50 observations required to conduct factor analysis and regression analysis. MacCullum, Browne, and Sugawara (1996) assert that small sample sizes with fewer parameters are associated with higher power.

4.11 Conclusion

This chapter discussed the research methodology and the philosophical position used in this research. This study used a survey research approach. Surveys are useful to test hypotheses and to generalise findings (Fawler, 2002). 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, et al., 1983).

This study based on the process-based management theory and the positivist paradigm assumptions (theoretical perspectives). The advantage of positivist research is that it can identify the precise relationships between chosen variables (Cavana & Sekaran, 2001; Chalmers, 1978). The research aimed to determine the SCI operational issues (factors) in the NZ public hospitals and their impact on supplier commercial relationships, focused SCI, and order fulfilment.

The responses to the interview questionnaire were analysed using cross-case analysis (Yin, 2003). The responses to the pilot study were initially analysed statistically using exploratory factor analysis (Hair, et al., 2006) to identify the factors with high values of Cronbach's alpha of 0.70 or more for existing scales and an alpha of 0.60 or more for newly created scales (Nunnally, 1978) to be used in the main study. Since the sample size for the pilot study was small for rigorous statistical analysis using SPSS exploratory factor analysis for most constructs, it was necessary to use the descriptive statistical analysis to determine good measurement items for the main study. The main study responses were analysed using SPSS version 17 for exploratory factor analysis, multiple regression analysis, and the correlation matrix.

The following chapter five discusses the data analysis and the results of this study.

CHAPTER 5.0: DATA ANALYSIS AND RESULTS

5.1 Introduction

The previous chapter discussed the research design and methodology adopted for this study. This chapter presents the data analysis techniques used in this study and results. The data analysis is conducted using a triangulation of techniques: factor analysis, correlation matrix, and multiple linear regression analysis (see section 4.10.4.1). This chapter is divided into eleven sections: (5.2) data editing and coding; (5.3) data screening: treatment of missing data, assessment of the normality; (5.4) profile of respondents; (5.5) analysis and results of factor analysis; (5.6) measurement model; (5.7) multiple linear regression analysis and test of hypotheses; (5.8) results of testing the hypotheses of this thesis; (5.9) Operational issues, supplier commercial relationships, and focused SCI impacts on order fulfilment; (5.10) Other considerations: supplier selection and recommendations to enhance SCI; (5.11) Summary.

5.2 Data editing and Coding

Following data collection from the public hospitals and the District Health Boards (DHBs) (see section 4.7.3 of final survey for explanation), editing of the data was undertaken in order to check the omission, completeness, and consistence of the data. Editing is a part of the data processing and analysis stage (Zikmund, 2003). There were no missing data for all measurement items in the constructs for the theoretical model. Missing data were present in the general information Section F because the informants thought some of the information requested could identify them or their hospital and the DHB. For example, some of the position titles were unique and available to big hospitals. Therefore, the available information is reported in Table 5.2 for the respondents. Data editing also helped to detect any errors in data entry.

Coding was used to allocate numbers to each answer (Malhotra, 1996) and facilitates the transfer of data from the questionnaire to SPSS version 17. Coding can be done before the questionnaire is answered (pre-coding) or after

(DeVaus, 1995). In this thesis, the coding procedure was conducted by establishing a data file in SPSS, and all measurement items were all pre-coded with numbers (see survey questionnaire in Appendix D).

5.3 Data screening

The missing data were noted in the general information section, and did not affect analysis of variables of the constructs. Therefore, there was no need to assess the pattern of missing data.

5.3.1 Treatment of missing data

As the initial stage in data analysis, screening for missing data, outliers, and normality was conducted. Data screening is necessary to make sure that data have been correctly recorded and that the distributions of variables to be used in the analysis are normal (Coakes, 2006). The initial analysis is discussed in the following sections.

5.3.2 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. 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 5.1), and that there is univariate normality. The final descriptive statistics for the items used in this thesis are also indicated in Table 5.1.

Table 5.1: 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 5.1 (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 5.1 (cont.)

Construct/ Items	Mean	Std. Deviation	Skewness	Kurtosis
Supplier commercial relationships (SC) cont.				
• 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
• 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 procurement 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 5.1 (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
• 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).

5.4 Profile of respondents

The data used for main study was collected from purchasing and supply (procurement) personnel from 61 organisations (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 indicated in Table 5.2.

Table 5.2: 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

5.5 Analysis and results of exploratory factor analysis

Exploratory factor analysis (EFA) was used to reduce data by identifying representative variables from a larger set of variables for use in multiple regression analysis.

(i) Factor analysis is a technique used to identify factors that statistically explain the variation and covariation among measures (Greem Salkind, & Akey, 2000).

(ii) Factor analysis can identify the structure of a set of variables as well as provide a process for data reduction (Hair, et al., 2006).

Factor analysis was carried out using SPSS version 17.

The Cronbach's alpha was used to evaluate the reliability of each scale. Alpha values over 0.7 indicate that all scales can be considered reliable (Nunnary, 1978). Hair et al. (2006) state that the alpha values of 0.60 to 0.70 deemed the lower limit of acceptability. Principal component analysis was used to extract factors with eigenvalues greater than 1. Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was used to validate the use of factor analysis. The KMO value of 0.50 or above shows the required sampling adequacy (Hair et al., 2006). Bartlett test sphericity is a statistical test for the overall significance of all correlations within the correlation matrix (Hair et al., 2006). Measure of sampling adequacy is a measure calculated both for the entire collection matrix and for each individual variable evaluating the appropriateness of applying factor analysis. Values of sampling above 0.50 for either the entire matrix or an individual variable indicate appropriateness (Hair, 1998, 2006).

Scree test is used to identify the optimum number of factors that can be extracted before the amount of unique variance begins to dominate the common variance structure (Cattell, 1966; Hair et al., 1998). The factor loadings above 0.3 are considered appropriate (Hair et al., 1998) for factor analysis. The final number of variables selected for each construct for further analysis was determined using a triangulation of methods: the principal component analysis with varimax rotation, the scree plot, and Cronbach's alpha (i.e., items with high inter-item correlation were selected) to meet the maximum variables required for multiple regression.

The face validity of the variables selected depends on the relationships with factors they are supposed to measure. Each variable (measurement item) has a different factor loading on each factor, but the highest loading for the variables on any factor was selected for further analysis. A factor loading is a correlation between the original variable and the factor, and the basis for understanding the nature of a factor (Hair, et al., 2006). The latent variables (unobservable) or constructs are normally operationalized in structural equation modelling (SEM). A latent construct cannot be measured directly but can be represented or measured by one or more variables (indicators) (Hair, et al., 2006). Confirmatory factor analysis using SEM was not possible due to the small sample (see section 4.10.4.2).

5.5.1 Factor analysis –supply chain integration initiatives

The factor analysis of supply chain integration initiatives and items turned out to be significant (KMO: 0.772; Bartlett's Test: Approx. chi-square: 142.580: degree of freedom (df) 6: Sig: 0.000). One factor was identified using extraction method: principal component analysis. The scree plot test also identified one factor. The variables SI1 and SI2 were selected for further analysis because they had high loading after extraction and the combination provided a high

Cronbach's alpha 0.798 for the construct (see Table 5.3). Factor 1 consists of the variables SI1, SI2, SI3.

Table 5.3: Factor analysis of supply chain integration initiatives

Item	Factor	Communality per variable
SI2 – Integration with customers	**0.312**	0.854
SI1 – Cross-functional process integration within the hospital	**0.310**	0.845
SI3 – Integration with first-tier suppliers	**0.307**	0.829
SI4 – Complete customers and suppliers supply chain integration	0.277	0.673
Eigenvalues	2.964	
Total explained variance per factor (%)	74.099	
Cronbach's alpha (2 items: SI1 and SI2) = 0.798		

Note: factor loadings were obtained using component matrix score coefficient. SPSS didn't produce a rotated component matrix because only one factor was extracted in the factor analysis.

Factor 1 has 2.964 eigenvalues (74.099% of variance explained). The communalities for the variables are within the range from 0.608 to 0.854.

5.5.2 Factor analysis – organisation strategy and SCI drivers

The factor analysis of the organisation strategy and SCI drivers items turned out to be significant (KMO: 0.719; Bartlett's Test Approx. Chi-square: 132.935; df10; Sig: 0.000). Two factors were identified (see Table 5.4).

Table 5.4: Factor analysis of organisation strategy and SC1 drivers

Item	Factor 1	Factor 2	Communality per variable
ST5 – Improving service level is another core driver influencing our SC1 in our hospital	**0.921**	0.063	0.851
ST4 – Lowering costs is a core driver of our SC1	**0.852**	0.201	0.766
ST1 – Our organisation's corporate strategy includes SCI	**0.767**	0.404	0.751
ST3 – Our organisation promotes integration through use of information technology	0.274	**0.870**	0.831
ST2 – We have a centralised purchasing department	0.114	**0.921**	0.860
Eigenvalues	2.938	1.122	
Total explained variance per factor (%)	58.77	22.43	
Cumulative explained total variance (%)	58.77	81.20	
Cronbach's alpha (2 items: ST1 and ST2) = 0.6			

Factor 1 consists of the variables ST1, ST4, and ST5. Factor 2 consists of the variables ST3 and ST2. The variables ST1 and ST2 were selected for further analysis because they had high loading after extraction and the combination provided a high Cronbach's alpha 0.6 for the construct. The scree plot also identified two factors. Factor 1 has 2.938 eigenvalues (58.77% of variance explained). Factor 2 has 1.122 eigenvalues (22.43% of variance explained). The communalities for the variables are within the range from 0.751 to 0.860.

5.5.3 Factor analysis – performance improvement and SCI

The factor analysis of the performance improvement and SCI turned out to be satisfactory (KMO: 0.688; Bartlett's Test: Approx. Chi-square: 295.408; df36; Sig: 000). Three factors were identified (see Table 5.5) for further analysis.

Table 5.5: Factor analysis of performance improvement and SC1

Item	Factor 1	Factor 2	Factor 3	Communality per variable
SP2 – Lowering cost of purchased items	**0.899**	- 0.066	0.114	0.826
SP9 – Total productivity	**0.817**	0.375	0.081	0.815
SP1 – Ability to handle expected challenges	**0.791**	0.390	0.152	0.802
SP8 – Responsiveness to customer requests	**0.600**	0.535	0.113	0.658
SP3 – Hospital profitability	0.478	0.078	**0.783**	0.848
SP7 – Overall customer satisfaction	0.350	**0.702**	0.202	0.656
SP5 – On-time delivery/due date performance	0.197	**0.741**	0.101	0.598
SP6 – Order fulfilment lead times	0.025	**0.846**	0.196	0.754
SP4 – Inventory costs	-0.043	0.314	**0.883**	0.881
Eigenvalues	4.444	1.378	1.016	
Total explained variance per factor (%)	49.375	15.311	11.294	
Cumulative explained total variance (%)	49.375	64.685	75.979	

Cronbach's alpha (3 items: SP1, SP2 and SP3) = 0.769

Factor 1 consists of the variables SP1, SP2, SP8, and SP9. Factor 2 consists the variables SP5, SP6 and SP7. Factor 3 consists of the variables SP3 and SP4. The variables SP1, SP2, and SP3 were selected for further analysis because they had high loading after extraction and the combination provided a high Cronbach's alpha 0.769 for the construct. The scree plot also identified three variables. Factor 1 has 4:444 eigenvalues (49.375% of variance explained). Factor 2 has 1.378 eigenvalues (15.311% of variance explained). Factor 3 has 1.016 eigenvalues (11.294% of variance explained). The communalities for the variables are within the range from 0.598 to 0.881.

5.5.4 Factor analysis – organisation environmental forces

The factor analysis of the organisation environmental forces indicated that results were sufficiently satisfactory (KMO: 0.488; Bartlett's Test Approx. Chi-square: 59.715; df 6; Sig: 0.000). Two factors were identified (see Table 5.6).

Table 5.6: Factor analysis of organisation environmental forces

Item	Factor 1	Factor 2	Communality per variable
SE3 – Desire to lower supply chain costs	**0.912**	- 0.018	0.832
SE4 – Desire to focus on core competence in services	**0.877**	0.235	0.824
SE2 – Customers have initiated integration efforts	0.028	**0.875**	0.767
SE1 – Suppliers have initiated integration effort	0.167	**0.871**	0.787
Eigenvalues	1.966	1.244	
Total explained variance per factor (%)	49.161	31.112	
Cumulative explained total variance (%)	49.161	80.273	
Cronbach's alpha (2 items: SE1 and SE2) = 0.711			

Factor 1 consists of the variables SE3 and SE4. Factor 2 consists of the variables SE1 and SE2. The variables SE1 and SE2 were selected for further analysis because they had high loading after extraction and the combination provided a high Cronbach's alpha 0.711 for the construct. The scree plot also identified two variables. Factor 1 has 1.966 eigenvalues (49.161% of variance explained). Factor 2 has 1.244 eigenvalues (31.112% of variance explained). The communalities for the variables are within the range from 0.767 to 0.832.

5.5.5 Factor analysis – Barriers to supply chain integration

The factor analysis of the barriers to supply chain integration was sufficiently satisfactory (KMO: 0.412; Bartlett's Test of Sphericity – Approx. Chi-square: 194.985; df 36; Sig: 0.000). Four factors were identified (see Table 5.7).

Table 5.7: Factor analysis performance improvement and SC1

Item	Factor 1	2	3	4	Communality per variable
SB2 – Difficult to establish relationships based on shared risks and rewards	**0.936**	0.068	0.028	- 0.100	0.892
SB1 – A lack of willingness to share information	**0.873**	0.015	0.065	0.326	0.873
SB6 – Budget limitation for supply chain resources	**0.510**	0.258	0.372	- 0.418	0.639
SB7 – Lack of suppliers to comply with agreed key performance indicators (KPIs)	0.215	- 0.360	**0.861**	- 0.033	0.918
SB4 – Inappropriate information systems	0.115	**0.697**	0.037	- 0.025	0.501
SB9 – Organisational boundaries prevent integration	0.059	0.522	- 0.014	**0.699**	0.765
SB8 – Government procurement policies and procedures	- 0.059	0.425	**0.847**	0.121	0.917
SB3 – Difficult to evaluate contribution of each supply chain member	0.058	- 0.167	0.071	**0.802**	0.679
SB5 – Inconsistent operating goals	0.012	**0.878**	0.002	- 0.035	0.773
Eigenvalues	2.408	1.808	1.425	1.316	
Total explained variance per factor (%)	26.7522	0.093	15.834	14.619	
Cumulative explained total variance (%)	26.752	46.845	62.679	77.298	
Cronbach's alpha (3 items: SB1, SB2 and SB4) = 0.625					

Factor 1 consists of the variables SB1, SB2, and SB6. Factor 2 consists of the variables SB4 and SB5. Factor 3 consists of the variables SB7 and SB8. Factor 4 consists of the variables SB3 and SB9.

The variables SB1, SB2, and SB4 were selected for further analysis because they had high loading after extraction and the combination provided a high Cronbach's alpha 0.625 for the construct. The scree plot also identified four factors. Factor 1 has 2.408 eigenvalues (26.752% of variance explained).

Factor 2 has 1.808 eigenvalues (20.043% of variance explained). Factor 3 has 1.425 eigenvalues (15.834 % of variance explained). Factor 4 has 1.316 eigenvalues (14.619% of variance explained). The communalities for the variables are within the range from 0.501 to 0.918.

5.5.6 Factor analysis – supplier commercial relationships

The factor analysis of the supplier commercial relationships was satisfactory (KMO: 0.535; Bartlett's Test Approx. Chi-square: 199.729; df 36; Sig: 0.000). Three factors were identified (see Table 5.8).

Table 5.8: Factor analysis of supplier commercial relationships

Item	Factor 1	Factor 2	Factor 3	Communality per variable
SC4 – We have joint or collaborative planning	**0.869**	- 0.075	0.236	0.816
SC3 – We have good process integration between suppliers customers and the DHB	**0.766**	0.027	- 0.262	0.656
SC5 – We make effective negotiations with suppliers	**0.760**	0.000	0.166	0.606
SC8 – We use a contract to maintain relationship	**0.632**	0.445	- 0.130	0.614
SC1 – We have reliable suppliers	**0.525**	0.210	- 0.601	0.680
SC6 – We use KPIs in judging our suppliers	0.262	**0.736**	0.178	0.642
SC2 – We promote partnership with dedicated suppliers	-0.253	**0.790**	0.156	0.712
SC9 – We have single source relationships	0.200	0.138	**0.792**	0.686
SC7 – We have a service level agreement	0.081	**0.823**	- 0.282	0.763
Eigenvalues	3.001	1.896	1.280	
Total explained variance per factor (%)	33.343	21.069	14.220	
Cumulative explained total variance (%)	33.343	54.413	68.633	
Cronbach's alpha (2 items: SC1 and SC3) = 0.679				

Factor 1 consists of the variables SC1, SC3, SC4, SC5, and SC8. Factor 2 consists of the variables SC2, SC6, and SC7. Factor 3 consists of the variable SC9.

The variables SC1 and SC3 were selected for further analysis because they had high loading after extraction and the combination provided a high Cronbach's alpha 0.679 for the construct. The scree plot also identified three factors. Factor 1 has 3.001 eigenvalues (33.343% of variance explained). Factor 2 has 1.896 eigenvalues (21.069% of variance explained). Factor 3 has

1.280 eigenvalues (14.220% of variance explained). The communalities for the variables are within the range from 0.606 to 0.816.

5.5.7 Factor analysis – focused supply chain integration

The factor analysis of the focused supply chain integration turned out to be satisfactory (KMO: 0.749; Bartlett's Test – Approx. Chi-square: 159.853, df 21, Sig: 0.000). Two factors were identified (see Table 5.9).

Table 5.9: Factor analysis of focused supply chain integration

Item	Factor 1	2	Communality per variable
FC2 – We follow national procurement policies and procedures	**0.844**	- 0.105	0.724
FC7 – Our organisational structure is good for internal supply chain integration	**0.817**	0.334	0.780
FC1 – Our service functions are integration	**0.752**	0.303	0.658
FC6 – We have good organisational culture that supports supply chain integration	0.585	**0.644**	0.756
FC3 – We use enterprise resource planning (ERP) system	0.219	**0.513**	0.311
FC5 – Top management is committed to supply chain integration	0.132	**0.842**	0.727
FC4 – We use an online purchasing system	0.012	**0.840**	0.705
Eigenvalues	3.353	1.308	
Total explained variance per factor (%)	47.898	18.684	
Cumulative explained total variance (%)	47.898	66.582	
Cronbach's alpha (2 items: FC1 and FC2) = 0.616			

Factor 1 consists of the variables FC1, FC2, and FC7. Factor 2 consists of the variables FC3, FC4, FC5, and FC6. The variables FC1 and FC2 were selected for further analysis because they had high loading after extraction and the combination provided a high Cronbach's alpha 0.616 for the construct. The scree plot also identified two factors. Factor 1 has 3.353 eigenvalues (47.898% of variance explained). Factor 2 has 1.308 eigenvalues (18.684% of variance explained). The communalities for the variables are within the range from 0.311 to 0.780.

5.5.8 Factor analysis – order fulfilment

The factor analysis of order fulfilment was satisfactory (KMO: 0.614; Bartlett's Test – Approx. Chi-square = 110.838; df. 28, Sig: 0.000). Three factors were identified (see Table 5.10)

Table 5.10: Factor analysis of order fulfilment

Item	Factor 1	2	3	Communality per variable
OF8 – We emphasize to suppliers that accuracy and efficiency of order fulfilment is important	**0.794**	- 0.148	0.304	0.745
OF3 – We make an effort to control ordering costs	**0.710**	0.103	0.043	0.517
OF6 – Suppliers (vendors) manage our inventory	**- 0.627**	-0.521	- 0.242	0.724
OF2 – We have collaborative planning, forecasting and replenishment (CPFR)	0.534	**0.573**	- 0.041	0.615
OF1 – We classify inventories according to their importance	0.448	0.207	**0.694**	0.725
OF7 – We do maintain high levels of emergency supplies	-0.059	-0.077	**0.884**	0.790
OF5 – We have capacity to respond to demand fluctuations	0.054	**0.604**	0.399	0.527
OF4 – Suppliers have capacity to meet the demand	-0.018	**0.813**	-0.050	0.665
Eigenvalues	2.697	1.536	1.074	
Total explained variance per factor (%)	33.710	19.204	13.429	
Cumulative explained total variance (%)	33.710	52.913	66.342	
Cronbach's alpha (3 items: OF1, OF2 and OF3) = 0.6				

Factor 1 consists of the variables OF3, OF6, and OF8. Factor 2 consists of the variables OF2, OF4, and OF5. Factor 3 consists of the variables OF1 and OF7. The variables OF1, OF2, and OF3 were selected for further analysis because they had high loading after extraction and the combination provided a high Cronbach's alpha 0.6 for the construct. The scree plot also identified three factors. Factor 1 has 2.697 eigenvalues (33.710% of variance explained). Factor 2 has 1.536 eigenvalues (19.204% of variance explained). Factor 3 has

1.074 eigenvalues (13.429% of variance explained). The communalities for the variables are within the range from 0.527 to 0.790.

5.6 Measurement model

Measurement analysis on questionnaires/ instruments is important for two reasons: (1) it furnishes confidence that the empirical findings accurately reflect the proposed constructs and (2) empirically validated scales can be used in other studies (Ahire, Golhar & Woller, 1996). The scale can be used only if it is reliable and valid. Scale validation is crucial for newly developed constructs. Measures of supplier commercial relationships; focused supply chain integration; organisation strategy and supply chain integration drivers, and order fulfilment are new. Measures of supply chain integration operational issues: supply chain integration initiatives, performance improvement and supply chain integration, organisation environmental forces, and barriers to supply chain integration constructs were adopted from Fawcett and Magnam (2001) and modified to suit the current study.

Reliability was first considered in Section 5.5 for factor analysis and Cronbach's alpha is the widely used measure of reliability. The unidimensionality of scale must be determined before its reliability is examined (Gerbing & Anderson, 1988).

5.6.1 Unidimensionality

Unidimensionality refers to "characteristic of a set of indicators that has only one underlying trait or concept in common" (Hair et al., 2006). In order to assess unidimensionality, factor analysis was used for each final construct. The principal component analysis with varimax rotation was used to analyse measurement items for each construct. The factor loadings and reliability for each construct are indicated in Table 5.11. Measurement items have factor loadings between 0.767 and 0.936 exceeding a minimum threshold value of 0.6 (Nunnally and Bernstein, 1994). The principal component analysis (with varimax rotation for supply chain integration initiatives construct was not rotated because only one factor was extracted. The factor loadings for the supply chain integration initiatives construct are component matrix score coefficients.

5.6.2 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 5.11 shows the reliabilities of final constructs. The newly developed constructs have reliabilities between 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 reliability of 0.625 and it was not removed because it has alpha value close to acceptable reliability for old construct. There was no improvement of reliability after removing a measurement item with low loading from each construct.

Table 5.11: 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	0.6
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	0.6
	OF3	0.884	

NOTE: The construct with two or three variables has only one component extracted. Therefore the solution cannot be rotated.

The indicators or variables in each construct (Table 5.11) are highly inter-correlated and highly reliable, showing that all indicators are measuring the same (latent) construct (Hair et al., 2006).

5.6.3: 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 construct validity is different from other constructs. High discriminant validity shows evidence that a construct is unique and captures some phenomena other measures do not (Hair et al., 2006).

Factor analysis conducted in the previous section 5.5 provides support for acceptable convergent validity. Table 5.11 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., 2006). 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 5.12) 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 5.12: Correlation matrix of construct measures

Item			Mean, S.D	1	2	3	4	5	6	7	8	9
			Pearson Correlation Coefficients and significance levels									
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**

Table 5.12: Correlation matrix of construct measures (cont.)

Item			Mean, S.D	1	2	3	4	5	6	7	8	9
10	SB1	Lack to share information	**(3.25, 0.856)**	**-.314***	**-.363****	**- .166**	**.183**	**-.188**	**-.292***	**.338****	**.311***	**.294***
11	SB2	Difficult to establish relationship	**(3.3, 0.889)**	**.206***	**-.140**	**-.117**	**.033**	**-.198**	**-.145**	**.395****	**.356****	**.382****
12	SB4	Inappropriate Information	**(3.867, 0.747)**	**-.412****	**-.324***	**-.212**	**-.077**	**-.330***	**-.327***	**-.150**	**.060**	**-.062**
13	SC1	Reliable suppliers	**(3.867, 0.596)**	**.252**	**.195**	**.015**	**.496****	**.055**	**.069**	**-.121**	**-.223**	**-.136**
14	SC3	Good process integration	**(3.417, 0.889)**	**.265***	**.475****	**.241**	**.300***	**.262***	**.424****	**-.034**	**.007**	**.075**
15	FC1	Functions are integrated	**(3.133, 0.911)**	**.535****	**.633****	**.541****	**.450****	**.577****	**.530****	**.254**	**-.010**	**.182**
16	FC2	National policies and procedures	**(3.883, 0.958)**	**.124**	**.078**	**.400****	**.344****	**.268***	**.243**	**.002**	**.064**	**.142**
17	OF1	Classify inventories	**(3.7, 0.849)**	**.098**	**.090**	**.358****	**.272***	**.334****	**.179**	**.150**	**.109**	**-.018**
18	OF2	Collaborative planning	**(3.333, 1.036)**	**.340****	**.307***	**.494****	**.227**	**.242**	**.199**	**.212**	**.234**	**.368****
19	OF3	Effort to Control Costs	**(3.667, 0.933)**	**.093**	**.068**	**.113**	**.274***	**.100**	**.238**	**.577****	**.140**	**.159**

Table 5.12: Correlation matrix of construct measures (Cont.)

Item			Mean, S.D	10	11	12	13	14	15	16	17	18	19
				Pearson Correlation Coefficients and significance levels									
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	SC1	Reliable suppliers	**(3.867, 0.596)**	**.000**	**-.243**	**-.307***	**1**						
14	SC3	Good process integration	**(3.417, 0.889)**	**-.273***	**-.182**	**-.094**	**.555****	**1**					
15	FC1	Functions are integrated	**(3.133, 0.911)**	**-.326***	**-.239**	**-.123**	**.377****	**.475****	**1**				
16	FC2	National policies and procedures	**(3.883, 0.958)**	**-.232**	**-.356****	**-.211**	**.240**	**.177**	**.445****	**1**			
17	OF1	Classify inventories	**(3.7, 0.849)**	**.082**	**-.350****	**-.037**	**.288***	**.168**	**.272***	**.227**	**1**		
18	OF2	Collaborative planning	**(3.333, 1.036)**	**.096**	**.037**	**-.139**	**.430****	**.399****	**.365****	**.006**	**.308***	**1**	
19	OF3	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 construct correlation matrix shows low correlations and high correlations among constructs which indicate acceptable convergent and discriminant validity. Negative correlations between constructs indicate early signs of negative relationships. High correlations between constructs show that some of the hypotheses proposed may be supported. Construct validity is a necessary prerequisite for theory testing (Bagozzi, 1980). Further analysis for convergent validity is indicated in Table 5.13. There is evidence that all factor loadings for items measuring the same construct are statistically significant (Gerbing and Anderson, 1988; Lin and Ding, 2005; Holmes-Smith et al., 2006). All factors have loadings greater than 0.5 and are statistically significant at the 0.01 level scales ($P < 0.001$). High correlations of measurement items in each scale are evidence of a convergent validity (Table 5.13). Cronbach's alpha values between 0.6 and 0.798 (Table 5.11) show that all scales are reliable. Table 5.12 shows the correlation matrix with the means and standard deviations for the final measures. Description statistics (means and standard deviations) were calculated and Pearson's bivariate correlations were determined for all final measures. The means are above 3 (for a 5-point likert scale) indicating respondents' agreement on the responses to the measurement items. Most of the variables are highly correlated with each other. The correlation matrix indicates 13 negative significant correlations out of 77 significant correlations at 0.01 and 0.05. Negative significant correlations are as follows:

- Lack of willingness to share information (SB1) has a negative significant impact on cross-functional process integration within the hospital, (SI1), integrations with customers, (SI2), lowering cost of purchased items (SP2), process integrations between suppliers, customers, and the DHB, and service functions to be integrated (FC1)
- Inappropriate information systems (SB4) has a negative significant impact on cross-functional process integration within the hospital (SI1), integration with customers (SI2), ability to handle expected challenges (SP1), lowering cost of purchased items (SP2)
- Using reliable suppliers (SC1) and effort to control ordering costs (OF3) both have a negative significant impact on inappropriate information systems

- Difficult to establish relationships based on shared risks and rewards (SB2) has a negative significant impact on classifying inventories according to their importance (OF1) and following national procurement policies and procedures (FC2)
- Integrated functions have a negative significant impact on lack of willingness to share information
- National policies and procedures have a negative significant impact on difficult to establish relationships based on shared risks and rewards
- Effort to control ordering costs has a negative impact on inappropriate information systems.

The key positive significant correlations include the following:

1. Centralised purchasing has a positive significant impact on cross functional process, integration with customers, and corporate strategy that includes SCI.
2. Lowering cost of items has a positive significant impact on cross functional process, integration with customers, corporate strategy that includes SCI, centralised purchasing, and ability to handle expected challenges.
3. Profitability has a positive significant impact on corporate strategy, centralised purchasing, ability to handle expected challenges, and lowering cost of purchased items.
4. Difficult to establish relationships based on shared risks and rewards has a positive significant impact on profitability, integration initiated by suppliers and suppliers, lack of willingness to share information.
5. Reliable suppliers have a positive significant impact on centralised purchasing and a negative impact on inappropriate information.
6. Good process integration has a positive impact on cross functional process, integration with customers, centralised purchasing, ability to handle expected challenges, lowering costs, reliable suppliers. Good process integration has a negative significant impact on lack of willingness to share information.
7. Integrated functions have positive significant impact on cross functional process, integration with customers, corporate strategy that includes SCI, centralised purchasing, ability to handle expected challenges, lowering costs, reliable suppliers, and good process integration.

8. National policies and procedures have a positive significant impact on corporate strategy that includes SCI, centralised purchasing, ability to handle expected challenges, and integrated functions.
9. Classifying inventories according to their importance has a positive significant impact on corporate strategy that includes SCI, centralised purchasing, ability to handle expected challenges, reliable suppliers, and integrated functions.
10. Collaborative planning has a positive significant impact on cross functional process, integration with customers, corporate strategy that includes SCI, customers initiated integration, reliable suppliers, good process integration, integrated functions, and classifying inventories according to their importance.
11. Effort to control ordering costs has a positive impact on centralised purchasing, profitability, lack of willingness to share information, classifying inventories according to their importance, and collaborative planning.

Table 5.13: 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. 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.

5.6.4: Univariate Statistics

The means and standard deviations of constructs used in this thesis are presented in Table 5.14. The averages for organisation environmental forces (SE) and barriers to supply chain integration are low compared to the other constructs. It shows that the environmental forces, such as suppliers, customers, hospitals, and DHBs have not completely integrated. In addition, the barriers to supply chain integration haven't been addressed adequately. This study proposes that barriers to supply chain integration must be solved first in order to have effective supply chain integration. Since the scales are valid and reliable (as evidenced from different tests), we can continue to hypotheses testing.

Table 5.14: Mean and standard deviations of composite variables

Construct	Mean	Std. Deviation
SI	3.65	0.715
ST	3.675	0.892
SP	3.611	0.649
SE	3.175	0.858
SB	3.472	0.629
SC	3.642	0.658
FC	3.508	0.795
OF	3.567	0.684

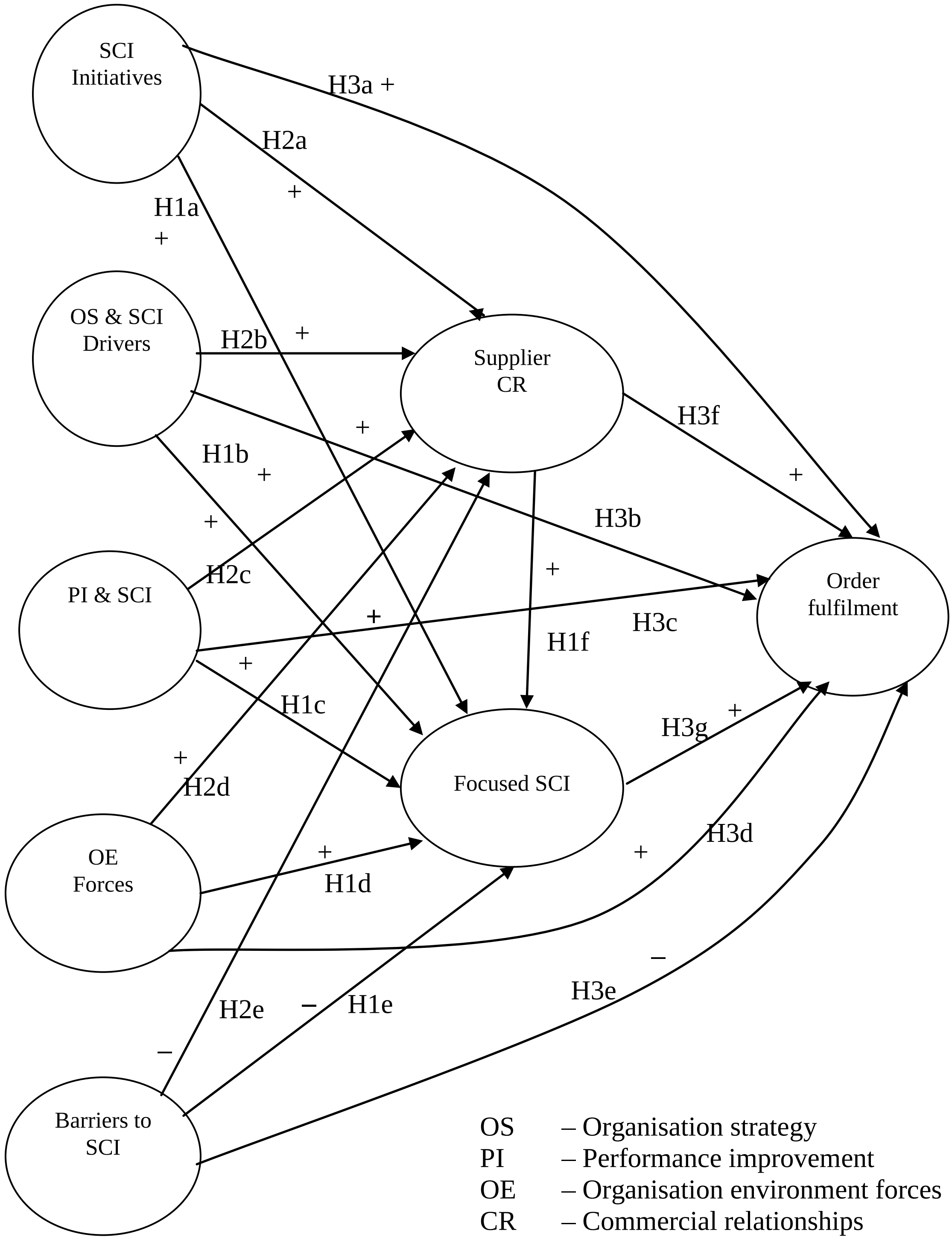
5.7 Multiple linear regression analysis and test of hypotheses

The model in Figure 5.1 was tested using SPSS version 17 for multiple linear 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 is used to predict 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 5.1).

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 relationships were not statistically significant and not supported. The hypotheses of this thesis are discussed in the following section 5.8. Appendix E (E1 – E18) indicates 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).

Figure 5.1: Research model and hypotheses

SCI operational issues



5.8 Results of testing the hypotheses

This thesis contains eighteen hypothesised relationships (see Chapter three, Tables 3.1a and 3.1b). Hypotheses testing results are in the Appendix E (E1 – E18). The implications of the hypotheses testing results are further discussed in Chapter six.

5.8.1 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 Appendix E1 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 (β = 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.

5.8.2 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 Appendix E2) 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 (β = 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 (β = 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.

5.8.3 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 Appendix E3 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 (β = 0.420, t = 2.908, p = 0.005; β = 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.

5.8.4 Organisation environment forces and focused supply chain integration

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

The results in Appendix E4 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 (β = - 0.160, t= - 1.033, p = 0.306; β = - 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 (β = 0.271, t = 1.749, p = 0.086; β = 0.153, t = 0.976, p = 0.333, respectively).

5.8.5 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 Appendix E5 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).

5.8.6 Supplier commercial relationships and focused supply chain integration

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

The results in Appendix E6 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 (β = 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.

5.8.7 Supply chain integration initiatives and supplier commercial relationships

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

The results in Appendix E7 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 (β = 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.

5.8.8 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 Appendix E8 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.

5.8.9 Performance improvement and supplier commercial relationships

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

The results in Appendix E9 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.

5.8.10 Organisation environment forces and supplier commercial relationships

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

The results in Appendix E10 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).

5.8.11 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 Appendix E11 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).

5.8.12 Supply chain integration and influence on order fulfilment

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

The regression results in Appendix E12 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.

5.8.13 Organisation strategy and order fulfilment

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

The regression results in Appendix E13 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 (β = 0.296, t = 2.201, p = 0.032), and another independent variable, centralised purchasing department, having a moderate positive impact on dependent variable (β = 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 (β = 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.

5.8.14 Performance improvement and order fulfilment

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

The regression results in Appendix E14 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 (β = 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 (β = 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.

5.8.15 Organisation environment forces and order fulfilment

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

The regression results in Appendix E15 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 (β = 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.

5.8.16 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 Appendix E16 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.

5.8.17 Supplier commercial relationships and order fulfilment

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

The regression results in Appendix E17 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.

5.8.18 Focused supply chain integration and order fulfilment

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

The regression results in Appendix E18 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 are depicted in Table 5.15. The models showing significant most important determinants (with regression model parameter estimates), are depicted in the Appendix F (F1 – F13).

Table 5.15 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 5.15 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

5.9 Operational issues, supplier commercial relationships, and focused SCI impacts on order fulfilment

The statistical results using correlation matrix are indicated in Appendix F (F8 – F13).

The correlation matrix results in Appendix F8 show that critical operational issues in SI1and SI2 have significant impact on supplier commercial relationships with determinant SC3, but only SI2 (integration with customers) was statistically significant in hypothesis H2a, using multiple regression analysis. The operational issue ST2 (we have a centralised purchasing department) has a statistical significant impact on supplier commercial relationships with determinants both SC1 (we have reliable suppliers) and SC2 (we promote partnership with dedicated suppliers). The results are statistically significant as in hypothesis H2b, using multiple regression analysis. The operational issue SP2 (lowering cost of purchased items) has a statistically significant impact on supplier commercial relationships with determinant SC3 and the result is similar to H2c, using multiple regression analysis. The operational issue SB1 (lack of willingness to share information) has a significant negative impact on SC3, but it was not significant in the hypothesis H2e. The operational issue SB4 (inappropriate information systems) has a statistically significant negative impact on supplier commercial relationships with determinant SC1. This result is similar to that of hypothesis H2e testing.

Appendix F9 indicates the results of the correlation matrix concerning the impact of critical operational issues on order fulfilment. The operational issues SI1 (cross-functional process integration within the hospital) and SI2 (integration with customers) both have positive statistically significant impact on order fulfilment with determinants OF2 (we have collaborative planning forecasting and replenishment). SI2 was not statistically significant in hypothesis H3a, using multiple regression analysis. The operational issue ST1 (our organisation's corporate strategy includes supply chain integration) has a statistically significant impact on order fulfilment determinants OF1 (we classify inventories according to their importance) and OF2. The result is similar to that of hypothesis H3b. Although ST2 is statistically significant and has positive impact on OF1 and OF3, only OF1 was statistically significant in the hypothesis H3b. The operational issues SP1 and SP3 are statistically significant and have impact on order fulfilment determinants OF1 and OF3 respectively. The results are similar to that of the hypothesis H3c. The operational issue SE2 (customers have initiated integration efforts) is statistically significant and has positive impact on OF2 (we have collaborative planning, forecasting and replenishment). The result is similar to that of the hypothesis H3d. The operational issues SB1, SB2, and SB4 are statistically significant and have negative (except SB1) impact on order fulfilment determinants OF1 (for SB2); OF1, OF2 and OF3 (for SB4). The result is similar to that of the hypothesis H3e testing.

Appendix F10 shows the results of the correlation matrix concerning the impact of critical operational issues on focused supply chain integration. The operational issue SI1 and SI2 are statistically significant and have positive impact on FC1, but the result of SI1 was not supported in hypothesis H1a testing, using multiple regression analysis. The operational issues ST1 and ST2 are statistically significant and have positive impact on focused SCI determinants FC1 and FC2, but ST2 is not supported in the hypothesis H1b testing, using multiple regression analysis. SP1 and SP2 operational issues are statistically significant and have positive impact on focused SCI determinants FC1 and FC2, but SP1 was not supported in the hypothesis H1c testing, using regression analysis. Operational issues SB1 and SB2 are statistically significant and have negative impact on focused SCI determinants FC1 and FC2, respectively. The results are similar to that of the hypothesis H1e testing, using multiple regression analysis.

Appendix F11 indicates the results of the correlation matrix regarding the impact of supplier commercial relationships on focused supply chain integration. The commercial relationships variables: SC1 (we have reliable suppliers) and SC3 (we have good process integration between suppliers, customers, and the DHB) have significant impact on focused supply chain integration determinant FC1 (our service functions are integrated). The result for SC3 is similar to that of the hypothesis H1f testing, using multiple regression analysis. The independent variable SC1 was not supported in the hypothesis H1f testing.

The correlation matrix results in Appendix F12 show that those supplier commercial relationships variables: SC1 and SC3 are statistically significant and have positive impact on OF2 (we have collaborative planning, forecasting, and replenishment). The result supports the findings in hypothesis H3f testing. Only SC1 has significant impact on OF1 (we classify inventories according to their importance), but it was not supported in hypothesis H3f testing. In addition, the hypothesis H3f testing results show that supplier commercial relationships variable SC3 is statistically significant and have negative impact on order fulfilment variable OF3 (an effort to control ordering costs).

Appendix F13 shows the results of the correlation matrix concerning the impact of focused supply chain integration on order fulfilment. The impact of focused supply chain integration variable FC1 (our service functions are integrated) on order fulfilment variables: OF1 and OF2 is positive and statistically significant. The finding supports the hypothesis H3g testing results for OF2 only. The H3g testing results show that integration of service functions (FC1) has no significant impact on classifying inventories according to their importance (OF1).

The differences between correlation matrix and hypotheses testing results in some cases might have been caused by the small sample used for multiple regression analysis. However, both analysis tools indicated important factors for answering the research questions and testing the hypotheses of this thesis.

5.10 Other considerations

5.10.1 Supplier Selection

Appendix F14 shows the key factors used by purchasing and supply personnel in the public hospitals for selecting suppliers. Quality is the most key factor in selecting the supplier followed by cost and customer service (specialist advice).

These key selection factors have helped the hospitals to build supplier commercial relationships to reduce costs, improve profitability, and fulfil the orders. Quality has the highest mean value followed by cost.

5.10.2 Recommendations to enhance SCI in public hospitals

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). Appendix F15 shows the descriptive statistics of the recommendations which were identified in the main study for this thesis. Similar results were achieved in the interviews and the pilot study.

5.11 Summary

This research used a triangulation of techniques for data analysis (e.g., factor analysis, correlation matrix, and multiple linear regression analysis) on the SCI operational factors and their impact on supplier commercial relationships, focused SCI, and order fulfilment in NZ public hospitals.

Data analysis in this thesis was carried out in four major sections. The first section of data analysis was data editing and coding. Data screening was conducted and checked for missing data, outliers, and normality, which is the condition for both factor analysis and multiple regression analysis used in this thesis. Both analysis tools need data to be normally distributed. The data were found normally distributed.

The second section of data analysis is the reliability and factor analysis using principal component analysis with varimax rotation to determine key factors with more than one eigenvalues and appropriate factor loadings, for further analysis using multiple regression analysis. Further reliability and validity analysis of the constructs of this thesis was carried out before multiple regression analysis and testing the hypotheses.

The measurement items which didn't improve the Cronbach's alpha (reliability measure) were removed from consideration for further analysis. Each construct was re-tested for reliability and validity. The results of all constructs' tests showed that constructs were reliable, and confirmed the suitability for use in the regression analysis and testing the hypotheses.

The third section is on testing the eighteen hypotheses for this thesis. Out of eighteen hypotheses, two hypotheses (H1d and H2d) were not supported. In addition, it was important to determine the models' parameter estimates of individual determinants (variables) for the models with statistical significance.

The fourth section is on general analysis of the supply chain integration issues and their impact on supplier commercial relationships and order fulfilment. They are analysed again in detail using the correlation matrix. The chapter also examined the key factors in supplier selection and the recommendations to improve supply chain integration in the public hospitals.

CHAPTER 6.0 DISCUSSION OF RESULTS AND CONCLUSIONS

6.1 Introduction

This chapter discusses the results reported in chapter five; evaluation of SCI operational issues, supplier commercial relationships, and focused SCI effects on order fulfilment; and answers the four research questions indicated in chapter one namely

(1) What are critical factors influencing SCI in NZ public hospital sector?;

(2) What is the impact of critical factors affecting the SCI on supplier commercial relationships and order fulfilment in NZ public hospital sector?;

(3) How the public hospital sector can effectively adopt SCI to improve supplier commercial relationships and to achieve the order fulfilment goals?;

(4) What are barriers to SCI practices in public hospitals?; and meeting the research objectives.

This chapter is divided into eight sections: 6.2 summary of the results ; 6.3 evaluation of SCI operational issues, supplier commercial relationships, and focused SCI impact on order fulfilment; 6.4 discussion of the results to answer the research questions (6.4.1 – 6.4.4); 6.5 research objectives; 6.6 implications: theoretical and managerial; 6.7 study limitations; 6.8 conclusion; and 6.9 future research.

6.2 Summary of the hypotheses tests

This thesis 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. 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 theoretical model discussed in Chapter three (section 3.3) 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 thesis support sixteen proposed hypotheses in the theoretical model and rejected two hypotheses. 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 two hypotheses not supported show that organisation environmental forces (suppliers or customers have initiated integration effort) do not have influence on focused supply chain integration (such as integrated service functions and following national procurement policies and procedures); 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). Due to a small sample size, this result needs confirmation through further research. These results of the null hypotheses show that integration initiated by suppliers or customers have little impact on the organisation’s focused supply chain integration and supplier commercial relationships.

The results of this thesis 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. This issue has not previously been researched in New Zealand and the results are significant for supply chain management.

6.2.1. The influences of supply chain integration operational issues on focused supply chain integration

According to the proposed model (section 3.3), this thesis 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 thesis 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 thesis demonstrate that organisation environmental forces, 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 thesis. The findings of this thesis are the first to provide an empirical insights on the influence of supply chain integration operational 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 thesis found other factors do not have significant influence on focused supply chain integration (see Appendix E: E1 – E6).

6.2.2 Supplier commercial relationships

In the proposed model, this thesis hypothesized that supplier commercial relationships have positive influence on focused supply chain integration. For hypothesis H1f, the 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 thesis 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 developted and tested (see Appendix E: E7 – E11).

The results 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. It is also shown 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 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.

6.2.3 Order fulfilment

From the analysis it is concluded that, integration of supply chain operational issues influence 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 Appendix E: E12 – E18). 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 integration 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 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 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 thesis 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 thesis 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 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 thesis.

The results of the hypotheses testing discussed above answers the research questions and fulfil the research objectives. This thesis 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. The thesis provides a comprehensive understanding of supply chain integration, supplier commercial relationships, and order fulfilment in public hospitals in New Zealand.

6.3 Evaluation of SCI operational issues, supplier commercial relationships, and focused SCI impacts on order fulfilment

In addition to the hypotheses testing using multiple regression analysis, the correlation matrix was also used to determine the relationships of variables used in this thesis (section 5.9 and discussed in section 6.2). The answer to the research question one is represented in Figure 6.1 (see section 6.4), and answers to the research question two are indicated in sections 6.3.1- 6.3.5. The sections 6.3.6 and 6.3.7 provide answers for the research questions three and four respectively.

6.3.1 The impact of critical operational issues on supplier commercial relationships

The results of the correlation matrix reveal that some of the critical operational issues do not have significant impact on supplier commercial relationships, as evidenced in the hypotheses testing results. The operational issues with significant impact on commercial relationships are: integration with customers (supported in H2a); centralised purchasing (supported in H2b); lowering cost of items (supported in H2c); and inappropriate information (supported in H2e). The operational issues which are significant, but not supported in the hypotheses testing are: cross-functional process integration (not supported in H2a) and lack of willingness to share information (not supported in H2e).

6.3.2 The impact of critical operational issues on order fulfilment

The operational issues with significant impact on order fulfilment are: cross-functional process integration in hospitals (supported in H3a); corporate strategy includes supply chain integration (supported in H3b); centralised purchasing department (supported in H3b, only for classifying inventories according to their importance (OF1)); ability to handle expected challenges (suported in H3c); hospital profitability (supported H3c); customers have initiated integration efforts (supported in H3d); lack of willingness to share information (supported in H3e); difficult to establish relationships based on shared risks and rewards (supported in H3e); and inappropriate information systems (supported in H3e). The operational issues which were thought to be significant, but not supported in the hypotheses testing are: integration with customers (not supported in H3a). This is a very interesting result because hospitals are supposed to integrate with customers in order to get information regarding their requirements effectively and efficiently. In addition, having a centralised purchasing department was not supported in H3b for an effort to control ordering costs (OF3). It seems that controlling ordering costs is possible only if centralised purchasing is done professionally. The result supports the finding of Scanlon (2000) who found that prices negotiated by purchasing groups were not always lower.

6.3.3 Impact of critical operational issues on the focused supply chain integration

The results of the correlation matrix show that some of the critical operational issues do not have significant impact on focused supply chain integration. The critical supply chain integration operational issues with significant impact on focused supply chain integration are: integration with customers (supported in H1a); organisation’s corporate strategy includes supply chain integration (supported in H1b); ability to handle expected challenges (supported in H1c, only for service functions are integrated); lowering cost of purchased items (supported in H1c); lack of willingness to share information (supported in H1e); and difficult to establish relationships based on shared risks and rewards (supported in H1e).

The critical operational issues which were found significant using the correlation matrix, but not supported in the hypotheses testing are: cross-functional process integration within the hospital (not supported in H1a); and having a centralised purchasing department (not supoprted in H1b). Further research on the impact of supply chain integration operational issues on focused supply chain integration is required to validate the findings of the multiple regression analysis and the correlation matrix results.

6.3.4 The impact of supplier commercial relationships on focused SCI

The results of the correlation matrix indicate that supplier commercial relationships have significant impact on focused supply chain integration. Reliable suppliers have significant impact on the integrated service functions, but not supported in H1f. However, supplier commercial relationships (i.e., good process integration between suppliers, customers, and the DHB) have significant impact on focused supply chain integration (i.e., integrated service functions). This result was supported in H1f.

6.3.5 The impact of supplier commercial relationships on order fulfilment

The results of the correlation matrix show that some of the commercial relationships variables do not have significant impact on order fulfilment. Reliable suppliers was found to have significant impact on order fulfilment (i.e., classifying inventories according to their importance and collaborative planning, forecasting and replenishment). Collaborative planning, forecasting and replenishment was the only variable supported in H3f. Also, good process integration between suppliers, customers, and the DHB have strong significant impact on order fulfilment (i.e., having collaborative planning, forecasting and replenishment). This result was supported in H3f.

This study indicates that the results of the hypotheses testing, using multiple regression analysis are in some cases slightly different from the results on impacts of variables using correlation matrix. This thesis makes a contribution to data analysis literature by providing results of the correlation matrix and the multiple regression analysis using same data from the public hospital sector.

6.3.6 How can the public hospital sector effectively adopt SCI to improve supplier commercial relationships and to achieve the order fulfilment goals?

The answer for this research question three is based on the recommendations from the respondents in the survey (see Chapter 5, section 5.10.2 and Appendix F15). Purchasing and supply personnel made the following recommendations in order of importance (see Table 6.1). The interviews with procurement managers revealed similar results.

Table 6.1: Recommendations to enhance supply chain integration in New Zealand public hospitals

Recommendation	**Rank**
Recognise procurement as a strategic function	1
Support from top management	2
Cement relationships with critical suppliers	3
Collaboration within and between the hospitals	4
Head of procurement must be qualified in supply chain management	5
Head of procurement should report to the chief executive	6
Top management must be trained in supply chain management	7

6.3.7 What are barriers to SCI practices in public hospitals?

The answer for this research question four is based on the discussion of results in sections 6.2 (hypotheses testing) and 6.3 (correlation matrix) results. The most critical significant SCI barriers are:

- Lack of willingness to share information
- Difficult to establish relationships based on shared risks and rewards
- Inappropriate information systems

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). This study identified lack of willingness to share information as the most supply chain integration barrier in the hospitals. But Fawcett and Magnan (2001) and Fawcett et al. (2008) in their study found inappropriate information systems as the most barrier to effective supply chain integration.

6.4 Reseach objectives

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 1.3): 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).

The research stresses the factors that are likely to affect SCI in public sector hospitals and other health service providers. In general, the research seeks to:

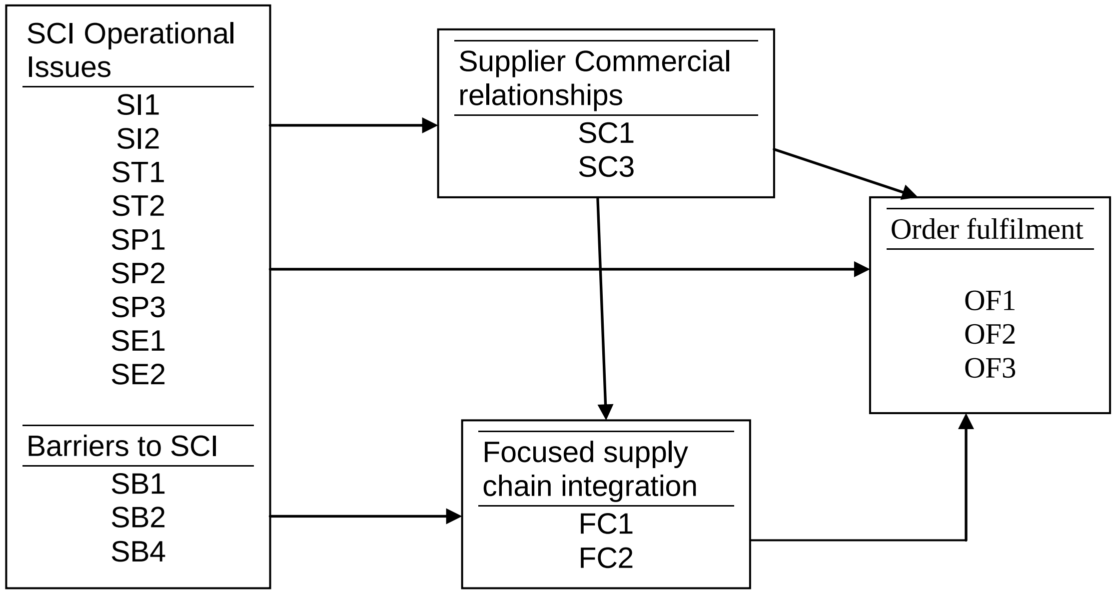
(a) Identify and examine the critical operational factors that are likely to affect the supply chain integration and their impact on supplier commercial relationships and order fulfilment in the NZ public hospital sector

This objective was achieved (see Chapter 5, sections 6.2 and 6.3).

(b) Develop a framework that determines necessary / required level of supply chain integration in NZ public hospital sector

This objective was achieved. The framework to enhance supply chain integration in NZ public hospital sector is indicated in Figure 6.1.

Figure 6.1: The 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 challenges

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

(c) Develop a model assessment and test of hypotheses for supply chain integration in the public hospital sector to achieve the order fulfilment goals and improve supplier commercial relationships.

This objective was achieved by conducting eighteen hypotheses testing (see sections 5.7 and 6.2). Since the confirmatory factor analysis (for path analysis) was not used in this thesis due to a small sample size, the multiple regression analysis was used for model assessment (section 5.8) and to determine model parameter estimates (see Tables 5.34 – 5.40).

6.5 Implications: theoretical and managerial

The primary aim of this research is to identify the critical operational factors influencing the supply chain integration and their impact on supplier commercial relationships and order fulfilment in the NZ public hospitals. The author could not find previous research that considered the implications of these three key areas together. Therefore, this research helps to close a gap in the literature.

6.5.1 Theoretical implications - Research implications for supply chain integration

Previous research suggests that there is a need to identify factors critical to the firm's success that enable the firm to link with specific companies (Lambert, Cooper & Pagh, 1998). This research provides insights on the public hospitals' supply chain integration efforts. One of the major contributions of this study is to provide evidence concerning critical supply chain integration operational factors and their impact on supplier commercial relationships and order fulfilment in New Zealand public hospitals.

6.5.1.1 Supply chain integration

Lambert (2004) emphasises that successful supply chain management needs cross-functional integration of key business processes within the firm and across the network of companies that consist of the supply chain. In addition, Lambert (2004) states that executives in many companies struggle to accomplish the required integration because they don’t fully understand the supply chain business processes and the linkages required to integrate eight key SCM processes (Chapter 1, Figure 2.1). This study examined two key SCM processes: supplier relationship management (with modification) and order fulfilment, and applied them to the public hospitals.

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). One of the contributions of this study is to conceptualise integration as focused supply chain integration (a mediator) in contrast to previous researches emphasising on holistic view of supply chain integration reported by Power (2005).

Focused supply chain integration is linked to supplier commercial relationships and order fulfilment in the public hospitals. The new construct of focused supply chain integration in this study refers to the targeted management behavioural issues which can have impact on organisation’s ability to integrate selected management processes and corporate culture practices in the hospitals. It was interesting to note that after conducting factor and reliability analysis, top management is committed to supply chain integration measurement was dropped.

6.5.1.2 Process-based management theory

One of the key theoretical contributions of this study is to furnish support for process-based management theory by using supplier commercial relationships (originally, supplier relationship management) and order fulfilment (Lambert, 2004, 2008), as constructs to study supply chain integration in New Zealand public hospitals. This study changed supplier relationship management to supplier commercial relationships in order to be more focused. There are many types of supplier relationships in the literature.

The results of this study support the process-based management theory which claim that successful supply chain management needs cross-functional integration of key business processes within the firm and across the network of companies that consist of the supply chain (Lambert, 2004, 2008). This study used proposed hypotheses designed to meet the purpose of process-based management theory. The constructs operationalised in this study are: SCI operational issues, supplier commercial relationships, focused supply chain integration, and order fulfilment. The theoretical major contributions from the analysis of each construct are as follows:

6.5.1.3 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 organisations 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 thesis 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 environmental forces, such as suppliers or customers initiated integration efforts are not predictors of integrated service functions. In addition, organisation environmental 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 thesis 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 thesis 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.

6.5.1.4 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, supplier 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 6.1), 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 6.1. This model adds important critical factors in the literature, which are required for effective SCI in organisations.

6.5.2 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 6.1) and follow the model/ framework (Figure 6.1) to facilitate supply chain integration.

6.6 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 led 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 responses from the pilot study didn't meet the minimum requirement of five observations for each variable to be analysed using factor analysis (Hair, et al., 2006). The second questionnaire for the main study was addressed to 350 purchasing and supply chain management personnel in public hospitals. 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, using structural equation modelling (Hair, et al., 2006).

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. Habermas (1984, 1987) argues that reality / knowledge claims are validated by personal truthfulness or sincerity.

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.

6.7 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 proposed by Lambert (2004, 2008). A new construct of focused supply chain integration and a theoretical model were developed for this study.

This research used a triangulation of techniques for data analysis: exploratory factor analysis (to determine critical factors) , correlation matrix (for relationships (impact) between variables), and multiple linear regression analysis (for testing hypotheses).

This research tested eighteen hypotheses. The results of this thesis 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 (i.e., cross-functional process within the hospital, integration with customers, lowering cost of purchased items, organisation's corporate strategy that includes SCI, centralised purchasing department, ability to handle expected challenges, customers have initiated integration effort) have positive influence on supplier commercial relationships (i.e., reliable suppliers, good process integration between suppliers, customers and the DHB), focused supply chain integration (i.e., integrated service functions, national procurement policies and procedures) and order fulfilment (i.e., collaborative planning, forecasting and replenishment, classify inventories according to their importance, an effort to control ordering costs). Barriers to supply chain integration (i.e., lack of willingness to share information, inappropriate information systems, difficult to establish relationships based on shared risks and rewards) have negative influence on supplier commercial relationships (i.e., reliable suppliers), focused supply chain integration (i.e., integrated service functions, national procurement policies and procedures), and order fulfilment (i.e., classify inventories according to their importance, an effort to control ordering costs).

The results for two hypotheses not supported in this thesis 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 significant 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 significant 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). Fawcett and 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 key barrier to effective supply chain integration in the public hospitals.

Although this study supports the findings in the literature on studies with emphasis on 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), this research provides significant contributions to the SCI, supplier commercial relationships, and order fulfilment literature and the practices of SCI in New Zealand public hospitals. This research also contributes to theoretical and practical knowledge by providing a new model for enhancing SCI in an organisation. The model can help researchers and managers to focus on important SCI, supplier commercial relationships, and order fulfilment factors. The critical SCI operational factors linkage to supplier commercial relationships, focused SCI, and order fulfilment have been tested for the first time. The results extend the SCI theory and can benefit both academics and practitioners.

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 recognising procurement as a strategic function, the importance of support from top management, and the need to 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 in other countries, which are interested in enhancing supply chain integration, using focused supply chain integration as a mediator for order fulfilment.

6.8 Future research

This thesis 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. Further research can examine whether geographical location of the public hospitals have impact on order fullfilment. 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 recommended for future studies in order to perform a confirmatory factor analysis and validate the survey instrument developed in this study. This thesis 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.

This thesis operationalised two (supplier 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 supply chain integration issues on customer relationship, customer service, demand, and returns (reverse) management.

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APPENDICES

APPENDIX A

Financial performance of the DHBs for the year ended 30 June 2004 and 2005

DHB	Item	Group Budget	Group actual	Group actual
		2005 $ 000	2005 $ 000	2004 $ 000
Auckland ****	Total operating revenue Net profit (deficit) Inventories	1166380 (83251) 9007	1214434 (58110) 8740	1128718 (44663) 9007
Bay of Plenty	Total operating revenue Net profit (deficit) Inventories	365385 330 2180	383018 6080 2290	340276 8454 2211
Cantebury	Total operating revenue Net profit (deficit) Inventories	942588 361 6594	893662 361 7000	849481 (1241) 6806
Capital & Cost	Total operating revenue Net profit (deficit) Inventories	558785 (1622) 4609	537173 6999 4430	523132 11 4632
Counties Manukau	Total operating revenue Net profit (deficit) Inventories	791235 (5478) 625	806642 311 266	690801 5978 539
Hawke's Bay	Total operating revenue Net profit (deficit) Inventories	286900 6361 2157	296931 6361 2047	 247 2035
Hutt Valley	Total operating revenue Net profit (deficit) Inventories	277904 52 902	254643 53 682	258177 230 862
Lakes	Total operating revenue Net profit (deficit) Inventories	195451 (900) 1250	201732 7011 1228	188559 3597 1192
Mid Central	Total operating revenue Net profit (deficit) Inventories	347942 (3) 1729	371804 8601 1913	322412 3078 1682
Nelson Marborough ****	Total operating revenue Net profit (deficit) Inventories	243766 (251) 2422	253900 2144 2038	228072 (1412) 2033
Northland ****	Total operating revenue Net profit (deficit) Inventories	316301 1634 2520	300582 (377) 2200	294287 364 2318
Otago ****	Total operating revenue Net profit (deficit) Inventories	390412 (697) 2951	418028 (750) 3047	378641 (9576) 2951

South Canterbury ****	Total operating revenue	106534	110638	102173
	Net profit (deficit)	(101)	2867	3507
	Inventories	750	710	763
Southland ****	Total operating revenue	182262	178167	167071
	Net profit (deficit)	(5661)	(5629)	978
	Inventories	1382	1196	1155
Tairawhiti	Total operating revenue	N/A		
	Net profit (deficit)			
	Inventories			
Taranaki	Total operating revenue	205949	221085	197038
	Net profit (deficit)	(630)	7133	4383
	Inventories	1800	2006	1957
Waikato	Total operating revenue	695091	664202	634672
	Net profit (deficit)	2084	206	170
	Inventories	5386	4847	5602
Wairarapa ****	Total operating revenue	81994	78426	75795
	Net profit (deficit)	(258)	(1007)	
	Inventories	484	436	
Waitemata	Total operating revenue	814427	823601	714035
	Net profit (deficit)	N/A	1443	(13905)
	Inventories	N/A	2652	1636
West Coast ****	Total operating revenue	83174	84256	78258
	Net profit (deficit)	(1676)	(2680)	(438)
	Inventories	597	578	578
Whanganui ****	Total operating revenue	N/A	144807	N/A
	Net profit (deficit)		(2062)	
	Inventories		1080	

Source: Annual Reports (DHB's websites)
N/A = Not available
**** = Deficits and high levels of inventory

Ministry of Health in NZ (2008). District Health Boards (DHBs). Retrieved May 5, 2008, from: http://www.moh.govt.nz/districthealthboards

Appendix B

Participant Information Sheet

DATE INFORMATION SHEET PRODUCED:

01 SEPTEMBER 2008

PROJECT TITLE

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

AN INVITATION

I am a doctoral student with the Management Department, Business School, at Auckland University of Technology. My PhD research is in the area of supply chain integration in New Zealand public hospitals.

I invite you to participate in this project which involves purchasing and supply personnel in the public hospitals. Your participation would be on a voluntary basis.

WHAT IS THE PURPOSE OF THIS RESEARCH?

The general aims of this project are to:

1. Identify and examine the critical factors that are likely to affect the supply chain integration and their impact on supplier commercial relationships and order fulfilment in the New Zealand public hospital sector
2. Identify existing problems in implementing supply chain integration in public hospitals
3. Develop a model of the critical factors influencing the supply chain integration in the public hospital sector to achieve the order fulfilment goals and improve supplier commercial relationships.

HOW WAS I CHOSEN FOR THIS INVITATION?

You were selected randomly from key people in purchasing and supply working in the public hospitals. You are requested to provide your views about supply chain integration issues in your hospital.

WHAT WILL HAPPEN IN THIS RESEARCH?

The data collected and its analysis will provide an insight on the current supply chain integration practices in public hospitals. The data analysis results could be published in academic journals. The anticipated benefits are indicated below.

WHAT ARE THE DISCOMFORTS AND RISKS?

Potential discomforts and risks are associated with the maintenance of privacy and confidentiality.

HOW WILL THESE DISCOMFORTS AND RISKS BE ALLEVIATED?

The information I ask for is totally anonymous. I don't need your name and the name of the hospital in a questionnaire and that is why there will be no issues of discomforts and risks regarding privacy and confidentiality.

WHAT ARE THE BENEFITS?

THE FINDINGS FROM THIS STUDY ARE INTENDED TO ENHANCE SUPPLY CHAIN INTEGRATION IN THE PUBLIC HOSPITALS. THE CONTRIBUTION WILL BE THE FOLLOWING:

- The identification of the critical factors influencing supply chain integration in the hospitals.
- The determination of influences on the level of supply chain integration in the hospitals.
- The identification of major factors that improve the service levels in terms of order fulfilment, and reduced supply chain operational costs.
- The identification of key factors that improve the effectiveness of supplier commercial relationships and order fulfilment.

In addition, this study will enhance the current process-based theory by adding other critical factors required to improve supply chain integration in an organisation.

HOW WILL MY PRIVACY BE PROTECTED?

This research does not seek to gather personal information from participants. The questionnaires are anonymous. No company data will be identified.

WHAT ARE THE COSTS OF PARTICIPATING IN THIS RESEARCH?

THE COST ASSOCIATED WITH YOUR PARTICIPATION IS THE TIME INVOLVED. THE QUESTIONNAIRE WILL TAKE BETWEEN TWENTY AND TWENTY FIVE MINUTES TO COMPLETE.

WHAT OPPORTUNITY DO I HAVE TO CONSIDER THIS INVITATION?

Please take a few days to consider this invitation. If you need further information or clarification of any aspects of the project, contact Kabossa Msimangira, (09) 918 4655,

e-mail: kabossa.msimangira@openpolytechnic.ac.nz

Please do remember that your participation is voluntary in this important project.

HOW DO I AGREE TO PARTICIPATE IN THIS RESEARCH?

If you decide to participate by completing the questionnaire, this will be considered as your consent.

WILL I RECEIVE FEEDBACK ON THE RESULTS OF THIS RESEARCH?

If you wish to receive a summary report of the findings of this research, please indicate on the last page of the questionnaire.

WHAT DO I DO IF I HAVE CONCERNS ABOUT THIS RESEARCH?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisors, *Associate Professor Nevan Wright, Department of Management, Auckland University of Technology, Ph*. (09) 921 9999 ext. 5711, e-mail: nevan.wright@aut.ac.nz

and Dr. Kamrul Ahsan, Department of Management, Auckland University of Technology, Ph. (09) 921 9999 ext. 5477, e-mail: kamrul.ahsan@aut.ac.nz

Concerns regarding the conduct of the research should be notified to the Executive Secretary, AUTEC, Madeline Banda, *madeline.banda@aut.ac.nz*, (09) 921 9999 ext 8044.

WHOM DO I CONTACT FOR FURTHER INFORMATION ABOUT THIS RESEARCH?

Researcher Contact Details:

Kabossa Msimangira, The Open Polytechnic of New Zealand, (09) 918 4655,

e-mail: kabossa.msimangira@openpolytechnic.ac.nz.

Project Supervisors Contact Details:

Associate Professor Nevan Wright, Department of Management, Auckland University of Technology, Ph. (09) 921 9999 ext. 5711, e-mail: nevan.wright@aut.ac.nz

Dr. Kamrul Ahsan, Department of Management, Auckland University of Technology, Ph. (09) 921 9999 ext. 5477, e-mail: kamrul.ahsan@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on 1 October 2008, AUTEC Reference number 07/115.

Survey Questionnaire (Pilot Study)

<u>Supply chain integration in New Zealand public hospitals: impact on supplier commercial relationships and order fulfilment</u>

The completion of this questionnaire is deemed to be consent to participate

Instructions

1. I would like to thank you for your participation in this study
2. Strict confidentiality of respondents will be maintained throughout the project. All responses will be treated as <u>anonymous</u>. Therefore, don't identify yourself and your organisation on this questionnaire, unless you request the summary of the study findings.
3. The questionnaire will take approximately 40 minutes to complete. Please return the completed survey in the self-addressed stamped envelop within 14 days.
4. If you would like a summary of the study findings, please tick the box at the end of the survey and provide me with your private e-mail.
5. If you have any questions regarding the project, please contact me:

   Kabossa Msimangira
   Kabossa.msimangira@openpolytechnic.ac.nz
   Phone number: (09) 918 4655
6. Please return the completed questionnaire to:

   Kabossa Msimangira
   Auckland Learning Centre
   The Open Polytechnic of New Zealand
   P.O. Box 6558, Wellesley Street, Auckland 1141

Please answer the following questions in parts A to D using the definition of the "supply chain integration" to mean:

An association of customers and suppliers who, using management techniques, work together to optimize their collective performance in the creation, distribution, and support of an end product. Supply chain integration is a continuous process that can be optimized only when original equipment manufacturers (OEMs), customers, and suppliers work together to improve their relationships and when all participants are aware of key activities at all levels in the chain (National Research Council, 2000, p. 27).
(This definition is also applicable to service organisations).

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 valued first-tier customers	❑	❑	❑	❑	❑
c. Integration with important 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	❑	❑	❑	❑	❑

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. Overall product cost	❑	❑	❑	❑	❑
i. Overall product quality	❑	❑	❑	❑	❑
j. Total productivity	❑	❑	❑	❑	❑
k. Responsiveness to customer requests	❑	❑	❑	❑	❑
l. Transportation costs	❑	❑	❑	❑	❑
m. Planned requirements from customers	❑	❑	❑	❑	❑

4. To what extent have 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 improve customer satisfaction	❑	❑	❑	❑	❑
d. Desire to lower supply chain costs	❑	❑	❑	❑	❑
e. Desire to focus on core competence in services	❑	❑	❑	❑	❑
f. Opportunity to build the best team of supply chain partners	❑	❑	❑	❑	❑

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. Lack of clear guidelines for managing supply chain alliances	❑	❑	❑	❑	❑
g. Lack of employee loyalty, motivation, and empowerment	❑	❑	❑	❑	❑
h. No systematic approach to measuring customer requirements	❑	❑	❑	❑	❑
i. Lack of good performance measures	❑	❑	❑	❑	❑
j. Organisational boundaries prevent integration	❑	❑	❑	❑	❑
k. Value-added processes are not accurately costed	❑	❑	❑	❑	❑
l. Budget limitation for supply chain resources	❑	❑	❑	❑	❑
m. Lack of suppliers to comply with agreed key performance indicators (KPIs)	❑	❑	❑	❑	❑
n. Government procurement policies and procedures	❑	❑	❑	❑	❑

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	❑	❑	❑	❑	❑
d. We have joint or collaborative planning	❑	❑	❑	❑	❑
e. We make effective negotiations with suppliers	❑	❑	❑	❑	❑
f. We have good level of trust in buyer – supplier relationships	❑	❑	❑	❑	❑
g. Quality of information shared is good	❑	❑	❑	❑	❑
h. We have increased level of strategic alliance with suppliers	❑	❑	❑	❑	❑
i. We have good communication with suppliers	❑	❑	❑	❑	❑
j. Power of the supplier has impact on relationship	❑	❑	❑	❑	❑
k. Our suppliers prefer electronic purchasing	❑	❑	❑	❑	❑
l. We have supplier development programme	❑	❑	❑	❑	❑
m. We value importance of measuring relationship	❑	❑	❑	❑	❑

n. We use KPIs in judging our suppliers	❑	❑	❑	❑	❑
o. We have a service level agreement	❑	❑	❑	❑	❑
p. We have continuous improvement programmes	❑	❑	❑	❑	❑
q. We have good relationship / trust with our third party buye	❑	❑	❑	❑	❑
r. We use a contract to maintain relationship	❑	❑	❑	❑	❑
s. We have single source relationships	❑	❑	❑	❑	❑

SECTION C: ORDER FULFILMENT

7. 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. We have reduced order fulfilment lead time	❑	❑	❑	❑	❑
g. We have an inventory policy of maintaining high level of inventory for critical items only	❑	❑	❑	❑	❑
h. We have an inventory policy for important items	❑	❑	❑	❑	❑
i. We have inventory policy for all items	❑	❑	❑	❑	❑
j. We have supplier – buyer integrated order planning	❑	❑	❑	❑	❑
k. Suppliers (vendors) manage our inventory	❑	❑	❑	❑	❑
l. Our deliveries from suppliers are on time and right quantity	❑	❑	❑	❑	❑
m. We emphasize to suppliers that accuracy and efficiency of order fulfilment is important	❑	❑	❑	❑	❑
n. We improve supplier performance using order fulfilment metrics (measures)	❑	❑	❑	❑	❑
o. We have a high stockturn (products are not spending a long time in storage)	❑	❑	❑	❑	❑
p. We do maintain high levels of emergency supplies	❑	❑	❑	❑	❑

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

SECTION D: FOCUSED SUPPLY CHAIN INTEGRATION

8. Please circle 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 an Enterprise Resource Planning (ERP) system e.g., SAP, Oracle, JD Edwards	❑	❑	❑	❑	❑
d. We use an ERP system for health sector	❑	❑	❑	❑	❑
e. We give high priority to consultation with other departments	❑	❑	❑	❑	❑
f. We have a national supply chain integration policy	❑	❑	❑	❑	❑
g. We have good service integration	❑	❑	❑	❑	❑
h. We have good networking and relationships with suppliers	❑	❑	❑	❑	❑
i. Top management is committed to supply chain integration process	❑	❑	❑	❑	❑
j. We have good organisational culture that supports supply chain integration	❑	❑	❑	❑	❑
k. We value supply chain management	❑	❑	❑	❑	❑
l. Our organisation structure is good for internal supply chain integration	❑	❑	❑	❑	❑

SECTION E: SUPPLIER SELECTION AND INTEGRATION

9. Please prioritize or rate your supplier selection factors on a scale of 1 – 10

(1 : least important and 10 : most important) (circle / tick the number).

Factor	Priority / Rank orders									
• Cost	1	2	3	4	5	6	7	8	9	10
• Past experience of reliability	1	2	3	4	5	6	7	8	9	10
• Lead time	1	2	3	4	5	6	7	8	9	10
• Reputation / Brand	1	2	3	4	5	6	7	8	9	10
• Quality	1	2	3	4	5	6	7	8	9	10
• Customer service (specialist advice)	1	2	3	4	5	6	7	8	9	10
• Response speed	1	2	3	4	5	6	7	8	9	10

• Flexibility (capacity)	1	2	3	4	5	6	7	8	9	10
• Innovation	1	2	3	4	5	6	7	8	9	10
• Financial position	1	2	3	4	5	6	7	8	9	10

10. Please rate the importance of Pharmac to your hospital in supplier decision making (tick the number).

Not sure Not important Important Very important

1 ❑ 2 ❑ 3 ❑ 4 ❑

11. Please state the type of system support for integration (e.g., ERP: SAP, Oracle – iProcurement, PeopleSoft, Baan, J.D. Edwards, etc.) used in your hospital(s).

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12. How can a public hospital in NZ enhance supply chain integration?

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 ❑
   Specialisation: ……………………………………………………
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 2006/7): 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

☐ Please send me a summary of the study findings **(Optional)**

Name: ……………………………………………………

E-mail address: ……………………………………

Appendix C1

Pilot survey items (Eigenvalues and Cronbach's alpha)

1. Measurement items for the construct SCI initiatives

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Eigenvalues
SCI initiatives	V1.Cross-functional process integration within the hospital (reworded) V2.Integration with valued first-tier customers V3.Integration with important first-tier suppliers V4.Complete customers and suppliers supply chain integration.	2.502 1.075 Deleted Deleted

Scale reliability: Cronbach's alpha 0.752.

2. Measurement items for the construct organisation strategy and SCI drivers

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Eigenvalues
Organisation strategy and SCI drivers	V5. Our organisation's corporate strategy includes supply chain integration V6.We have a centralised purchasing department V7. Our organisation promotes integration through use of information technology	3.001 1.461 Deleted

	V8. Lowering costs is a core driver of our supply chain integration	Deleted
	V9. Improving service level is another core driver influencing our supply chain integration in our hospital.	Deleted

Scale reliability: Cronbach's alpha 0.800.

3. Measurement items for the construct performance improvement and SCI

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	**Measurement item**	**Eigenvalues**
Performance improvement and SCI	V10.Ability to handle expected challenges	4.877
	V11.Lowering cost of purchased items (reworded)	2.551
	V12.Hospital profitability (reworded)	1.819
	V13.Inventory costs	1.464
	V14.On-time delivery/Due-date performance	Deleted
	V15.Order fulfilment lead times	Deleted
	V16.Overall customer satisfaction	Deleted
	V17.Overall product cost	Deleted
	V18.Overall product quality	Deleted
	V19.Total productivity	Deleted
	V20.Responsiveness to customer requests	Deleted
	V21.Transportation costs	Deleted
	V22.Planned requirements from customers	Deleted

Scale reliability: Cronbach's alpha 0.813.

4. Measurement items for the construct organisation environmental forces

To what extent have the following led your hospital to seek greater supply chain integration?

The items were measured using a Likert scale that ranged from 1 (Not a critical factor) to 5 (Is a critical factor).

Construct	Measurement item	Eigenvalues
Organisation environmental forces	V23.Suppliers have initiated integration effort	4.144
	V24.Customers have initiated integration efforts	Deleted
	V25.Desire to improve customer satisfaction	Deleted
	V26.Desire to lower supply chain costs	Deleted
	V27.Desire to focus on core competence in services	Deleted
	V28.Opportunity to build the best team of supply chain partners	Deleted

Scale reliability: Cronbach's alpha 0.888.

5. Measurement items for the construct barriers to SCI

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

The items were measured using a Likert scale that ranged from 1 (Is not a serious barrier) to 5 (Is a serious barrier).

Construct	Measurement item	Eigenvalues
Barriers to SCI	V29. Lack of willingness to share information (reworded)	4.766
	V30.Difficult to establish relationships based on shared risks and rewards	3.805
	V31.Difficulty to evaluate contribution of each supply chain member	1.915
	V32.Inappropriate information systems (reworded)	1.350
	V33.Inconsistent operating goals	1.013
	V34.Lack of clear guidelines for managing supply chain alliances	Deleted
	V35.Lack of employee loyalty, motivation, and empowerment	Deleted

	V36.No systematic approach to measuring customer requirements	Deleted
	V37.Lack of good performance measures	Deleted
	V38.Organisational boundaries prevent integration	Deleted
	V39.Value-added processes are not accurately costed	Deleted
	V40.Budget limitation for supply chain resources	Deleted
	V41.Lack of suppliers to comply with agreed key performance indicators (KPIs)	Deleted
	V42.Government procurement policies and procedures	

Scale reliability: Cronbach's alpha 0.788.

6. Measurement items for the construct supplier commercial relationships

Please tick the number that best reflects your agreement with the following statements concerning supplier commercial relationships in your hospital. The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	**Measurement item**	**Eigenvalues**
Supplier commercial relationships	V43.We have reliable suppliers	8.878
	V44.We promote partnership with dedicated suppliers	3.466
	V45.We have good process integration between suppliers, customers, and the District Health Board (DHB)	2.707
	V46.We have joint or collaborative planning	1.716
	V47.We make effective negotiations with suppliers	1.193
	V48.We have good level of trust in buyer – supplier relationships	Deleted
	V49.Quality of information shared is good	Deleted
	V50.We have increased level of strategic alliance	

	with suppliers	Deleted
	V51.We have good communication with suppliers	Deleted
	V52.Power of the supplier has impact on relationship	Deleted
	V53.Our suppliers prefer electronic purchasing	Deleted
	V54.We have supplier development programme	Deleted
	V55.We value importance of measuring relationship	Deleted
	V56.We use KPIs in judging our suppliers	Deleted
	V57.We have a service level agreement	Deleted
	V58.We have continuous improvement programmes	Deleted
	V59.We have good relationship / trust with our third party buyer	Deleted
	V60.We use a contract to maintain relationship	Deleted
	V61.We have single source relationships	Deleted

Scale reliability: Cronbach's alpha 0.853.

7. Measurement items for the construct focused SCI

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Eigenvalues
Focused SCI	V62.Our service functions are integrated	7.082
	V63.We follow national procurement policies and procedures	1.946
	V64.We use an Enterprise Resource Planning (ERP) system e.g., SAP, Oracle, JD Edwards	1.468
	V65.We use an ERP system for health sector	Deleted
	V66.We give high priority to consultation with other departments	Deleted
	V67.We have a national supply chain integration policy	Deleted
	V68.We have good service integration	Deleted
	V69.We have good networking and build with supplier	Deleted
	V70.Top management is committed to supply chain integration processes	Deleted
	V71.We have good organisational culture that	Deleted
	supports supply chain integration	Deleted
	V72.We value supply chain management	
	V73. Our organisation structure is good for internal supply chain integration	Deleted

Scale reliability: Cronbach's alpha 0.897.

8. Measurement items for the construct order fulfilment

Please circle the number that best reflects your agreement with the following statements concerning order fulfilment in your hospital. The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Eigenvalues
Order fulfilment	V74.We classify inventories according to their importance	6.275
	V75.We have collaborative planning, forecasting and replenishment (CPFR)	3.695

	V76.We make an effort to control ordering costs	2.087
	V77.Suppliers have capacity to meet the demand	1.498
	V78.We have capacity to respond to demand	1.231
	V79.We have reduced order fulfilment lead time	Deleted
	V80.We have an inventory policy of maintaining high level of inventory for critical items only	Deleted
	V81.We have an inventory policy for important items	Deleted
	V82.We have inventory policy for all items	Deleted
	V83.We have supplier – buyer integrated order Planning	Deleted
	V84.Suppliers (vendors) manage our inventory	Deleted
	V85.Our deliveries from suppliers are on time and right quantity	Deleted
	V86.We emphasize to suppliers that accuracy and efficiency of order fulfilment is important	Deleted
	V87.We improve supplier performance using order fulfilment metrics (measures)	Deleted
	V88.We have a high stockturn (products are not spending a long time in storage)	Deleted
	V89.We do maintain high levels of emergency supplies	Deleted

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

Scale reliability: Cronbach’s alpha 0.762.

Appendix C2

Pilot survey items (Loading and Cronbach's alpha)

1. Measurement items for the construct SCI initiatives

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Loading
SCI initiatives	V1.Cross-functional process integration within the hospital (reworded)	0.936
	V2.Integration with valued first-tier customers	0.921
	V3.Integration with important first-tier suppliers	0.960
	V4.Complete customers and suppliers supply chain integration.	0.760

Extraction method: principal component analysis

Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) = 0.563 (values > 0.5 are acceptable).

Bartlett's test of sphericity = sig. 0.000 (Bartlett's test is highly significant if $p < 0.001$, and therefore factor analysis is appropriate).

Scale reliability: Cronbach's alpha 0.752.

2. Measurement items for the construct organisation strategy and SCI drivers

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Loading
Organisation strategy and SCI drivers	V5. Our organisation's corporate strategy includes supply chain integration	0.968
	V6.We have a centralised purchasing department	0.919
	V7. Our organisation promotes integration through use of information technology	0.907
	V8. Lowering costs is a core driver of our supply chain integration	0.770
	V9. Improving service level is another core driver influencing our supply chain integration in our hospital.	0.897

Extraction method: principal component analysis

Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) = 0.564 (values > 0.5 are acceptable).

Bartlett's test of sphericity = sig. 0.000 (Bartlett's test is highly significant if $p < 0.001$, and therefore factor analysis is appropriate).

Scale reliability: Cronbach's alpha 0.800.

3. Measurement items for the construct performance improvement and SCI

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Loading
Performance improvement and SCI	V10.Ability to handle expected challenges	0.945
	V11.Lowering cost of purchased items (reworded)	0.770
	V12.Hospital profitability (reworded)	0.779
	V13.Inventory costs	0.788
	V14.On-time delivery/Due-date performance	0.852
	V15.Order fulfilment lead times	0.557

	V16.Overall customer satisfaction	0.761
	V17.Overall product cost	0.947
	V18.Overall product quality	0.797
	V19.Total productivity	0.781
	V20.Responsiveness to customer requests	0.929
	V21.Transportation costs	0.911
	V22.Planned requirements from customers	0.892

Extraction method: principal component analysis
Scale reliability: Cronbach's alpha 0.813.
KMO and Bartlett's test were not feasible.

4. Measurement items for the construct organisation environmental forces

To what extent have the following led your hospital to seek greater supply chain integration?
The items were measured using a Likert scale that ranged from 1 (Not a critical factor) to 5 (Is a critical factor).

Construct	**Measurement item**	**Loading**
Organisation environmental forces	V23.Suppliers have initiated integration effort	0.729
	V24.Customers have initiated integration efforts	0.533
	V25.Desire to improve customer satisfaction	0.816
	V26.Desire to lower supply chain costs	0.531
	V27.Desire to focus on core competence in services	0.833
	V28.Opportunity to build the best team of supply chain partners	0.702

Extraction method: principal component analysis
Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) = 0.343 (values > 0.5 are acceptable).
Bartlett's test of sphericity = sig. 0.000 (Bartlett's test is highly significant if $p < 0.001$, and therefore factor analysis is appropriate).
Scale reliability: Cronbach's alpha 0.888.

5. Measurement items for the construct barriers to SCI

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

The items were measured using a Likert scale that ranged from 1 (Is not a serious barrier) to 5 (Is a serious barrier).

Construct	**Measurement item**	**Loading**
Barriers to SCI	V29. Lack of willingness to share information (reworded)	0.935
	V30.Difficult to establish relationships based on shared risks and rewards	0.938
	V31.Difficulty to evaluate contribution of each supply chain member	0.986
	V32.Inappropriate information systems (reworded)	0.993
	V33.Inconsistent operating goals	0.952
	V34.Lack of clear guidelines for managing supply chain alliances	0.896
	V35.Lack of employee loyalty, motivation, and empowerment	0.947
	V36.No systematic approach to measuring customer requirements	0.863
	V37.Lack of good performance measures	0.996
	V38.Organisational boundaries prevent integration	0.732
	V39.Value-added processes are not accurately costed	0.928
	V40.Budget limitation for supply chain resources	0.938
	V41.Lack of suppliers to comply with agreed key performance indicators (KPIs)	0.771
	V42.Government procurement policies and procedures	0.972

Extraction method: principal component analysis

KMO and Bartlett's test of sphericity were not feasible.

Scale reliability: Cronbach's alpha 0.788.

6. Measurement items for the construct supplier commercial relationships

Please tick the number that best reflects your agreement with the following statements concerning supplier commercial relationships in your hospital. The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	**Measurement item**	**Loading**
Supplier commercial relationships	V43.We have reliable suppliers	0.939
	V44.We promote partnership with dedicated suppliers	0.988
	V45.We have good process integration between suppliers, customers, and the District Health Board (DHB)	0.999
	V46.We have joint or collaborative planning	0.983
	V47.We make effective negotiations with suppliers	0.938
	V48.We have good level of trust in buyer – supplier relationships	0.8
	V49.Quality of information shared is good	0.911
	V50.We have increased level of strategic alliance with suppliers	0.890
	V51.We have good communication with suppliers	0.939
	V52.Power of the supplier has impact on relationship	0.993
	V53.Our suppliers prefer electronic purchasing	0.997
	V54.We have supplier development programme	0.972
	V55.We value importance of measuring relationship	0.940
	V56.We use KPIs in judging our suppliers	0.999
	V57.We have a service level agreement	0.973
	V58.We have continuous improvement programmes	0.890
	V59.We have good relationship / trust with our third party buyer	0.909
	V60.We use a contract to maintain relationship	0.993
	V61.We have single source relationships	0.909

Extraction method: principal component analysis

KMO and Bartlett's test of sphericity were not feasible.

Scale reliability: Cronbach's alpha 0.853.

7. Measurement items for the construct focused SCI

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Loading
Focused SCI	V62.Our service functions are integrated	0.867
	V63.We follow national procurement policies and procedures	0.813
	V64.We use an Enterprise Resource Planning (ERP) system e.g., SAP, Oracle, JD Edwards	0.895
	V65.We use an ERP system for health sector	0.909
	V66.We give high priority to consultation with other departments	0.976
	V67.We have a national supply chain integration policy	0.813
	V68.We have good service integration	0.896
	V69.We have good networking and build with supplier	0.799
	V70.Top management is committed to supply chain integration processes	0.864
	V71.We have good organisational culture that supports supply chain integration	0.815
	V72.We value supply chain management	0.964
	V73. Our organisation structure is good for internal supply chain integration	0.885

Extraction method: principal component analysis

KMO and Bartlett's test of sphericity were not feasible.

Scale reliability: Cronbach's alpha 0.897.

8. Measurement items for the construct order fulfilment

Please circle the number that best reflects your agreement with the following statements concerning order fulfilment in your hospital. The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	**Measurement item**	**Loading**
Order fulfilment	V74.We classify inventories according to their importance	0.803
	V75.We have collaborative planning, forecasting and replenishment (CPFR)	0.984
	V76.We make an effort to control ordering costs	0.872
	V77.Suppliers have capacity to meet the demand	0.979
	V78.We have capacity to respond to demand	0.982
	V79.We have reduced order fulfilment lead time	0.975
	V80.We have an inventory policy of maintaining high level of inventory for critical items only	0.573
	V81.We have an inventory policy for important items	0.989
	V82.We have inventory policy for all items	0.884
	V83.We have supplier – buyer integrated order planning	0.963
	V84.Suppliers (vendors) manage our inventory	0.981
	V85.Our deliveries from suppliers are on time and right quantity	0.993
	V86.We emphasize to suppliers that accuracy and efficiency of order fulfilment is important	0.928
	V87.We improve supplier performance using order fulfilment metrics (measures)	0.963
	V88.We have a high stockturn (products are not spending a long time in storage)	0.984
	V89.We do maintain high levels of emergency supplies	0.936

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

Extraction method: principal component analysis

KMO and Bartlett's test of sphericity were not feasible.

Scale reliability: Cronbach's alpha 0.762.

Appendix C3

Pilot survey items (Mean values and Std. deviation)

1. Measurement items for the construct SCI initiatives

To what extent is your hospital actively engaged in supply chain integration initiatives? The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Mean n=12	Std. Dev.
SCI initiatives	V1.Cross-functional process integration within the hospital	3.00	0.85
	V2.Integration with valued first-tier customer	3.17	0.72
	V3.Integration with important first-tier suppliers	3.08	0.79
	V4.Complete customers and suppliers supply chain integration.	2.58	0.9

Std. dev. = Standard deviation.

2. Measurement items for the construct organisation strategy and SCI drivers

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Mean n=12	Std. Dev.
Organisation strategy and SCI drivers	V5. Our organisation's corporate strategy includes supply chain integration	3.00	1.53
	V6.We have a centralised purchasing department	3.08	1.38
	V7. Our organisation promotes integration through use of information technology	3.00	1.28

	V8. Lowering costs is a core driver of our supply chain integration	3.92	0.9
	V9. Improving service level is another core driver influencing our supply chain integration in our hospital	4.00	0.74

3. Measurement items for the construct performance improvement and SCI

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Mean n=12	Std. Dev.
Performance improvement and SCI	V10.Ability to handle expected challenges	3.17	0.94
	V11.Lowering cost of purchased items	3.42	0.79
	V12.Hospital profitability	3.33	0.65
	V13.Inventory costs	3.5	0.8
	V14.On-time delivery/Due-date performance	4.0	0.43
	V15.Order fulfilment lead times	3.92	0.29
	V16.Overall customer satisfaction	3.58	0.67
	V17.Overall product cost	3.17	0.84
	V18.Overall product quality	3.17	0.72
	V19.Total productivity	3.42	0.67
	V20.Responsiveness to customer requests	3.67	0.89
	V21.Transportation costs	2.83	0.84
	V22.Planned requirements from customers	2.91	0.79

4. Measurement items for the construct organisation environmental forces

To what extent have the following led your hospital to seek greater supply chain integration?

The items were measured using a Likert scale that ranged from 1 (Not a critical factor) to 5 (Is a critical factor).

Construct	Measurement item	Mean n=12	Std. Dev.
Organisation environmental forces	V23.Suppliers have initiated integration effort	3.83	0.84
	V24.Customers have initiated integration efforts	3.25	1.29
	V25.Desire to improve customer satisfaction	4.17	0.72
	V26.Desire to lower supply chain costs	4.25	0.87
	V27.Desire to focus on core competence in services	3.75	1.14
	V28.Opportunity to build the best team of supply chain partners	3.00	1.48

5. Measurement items for the construct barriers to SCI

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

The items were measured using a Likert scale that ranged from 1 (Is not a serious barrier) to 5 (Is a serious barrier).

Construct	Measurement item	Mean n=12	Std. Dev.
Barriers to SCI	V29. Lack of willingness to share information	3.75	0.87
	V30.Difficult to establish relationships based on shared risks and rewards	3.92	0.67
	V31.Difficulty to evaluate contribution of each supply chain member	2.5	0.52
	V32.Inappropriate information systems	4.33	0.49
	V33.Inconsistent operating goals	3.67	1.3
	V34.Lack of clear guidelines for managing supply chain alliances	4.08	0.99
	V35.Lack of employee loyalty, motivation, and		

	empowerment	3.17	1.19
	V36.No systematic approach to measuring customer requirements	2.92	1.38
	V37.Lack of good performance measures	3.33	1.16
	V38.Organisational boundaries prevent integration	4.25	0.87
	V39.Value-added processes are not accurately costed	3.83	0.72
	V40.Budget limitation for supply chain resources	3.83	1.03
	V41.Lack of suppliers to comply with agreed key performance indicators (KPIs)	2.5	0.67
	V42.Government procurement policies and procedures	3.33	1.44

6. Measurement items for the construct supplier commercial relationships

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	**Measurement item**	**Mean n=12**	**Std. Dev.**
Supplier commercial relationships	V43.We have reliable suppliers	3.33	0.78
	V44.We promote partnership with dedicated suppliers	4.33	0.65
	V45.We have good process integration between suppliers, customers, and the District Health Board (DHB)	2.67	0.89
	V46.We have joint or collaborative planning	2.83	1.19
	V47.We make effective negotiations with suppliers	3.58	0.67
	V48.We have good level of trust in buyer – supplier relationships	3.42	0.52

	V49.Quality of information shared is good	2.50	1.17
	V50.We have increased level of strategic alliance with suppliers	3.17	1.03
	V51.We have good communication with suppliers	3.42	0.9
	V52.Power of the supplier has impact on relationship	4.17	0.39
	V53.Our suppliers prefer electronic purchasing	4.25	0.75
	V54.We have supplier development programme	2.42	0.9
	V55.We value importance of measuring relationship	3.42	1.24
	V56.We use KPIs in judging our suppliers	3.33	1.23
	V57.We have a service level agreement	3.67	0.65
	V58.We have continuous improvement programmes	3.17	1.03
	V59.We have good relationship / trust with our third party buyer	3.25	0.75
	V60.We use a contract to maintain relationship	3.50	1.17
	V61.We have single source relationships	3.00	1.04

7. Measurement items for the construct focused SCI

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

The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Mean n=12	Std. Dev.
Focused SCI	V62.Our service functions are integrated	2.25	0.97
	V63.We follow national procurement policies and procedures	3.25	0.97
	V64.We use an Enterprise Resource Planning (ERP) system e.g., SAP, Oracle, JD Edward	2.83	1.7
	V65.We use an ERP system for health sector	2.33	1.3
	V66.We give high priority to consultation with other departments	3.42	0.99
	V67.We have a national supply chain integration policy	2.50	1.38
	V68.We have good service integration	3.00	0.74
	V69.We have good networking and build with supplier	3.67	0.65
	V70.Top management is committed to supply chain integration processes	2.67	0.99
	V71.We have good organisational culture that supports supply chain integration	2.33	0.89
	V72.We value supply chain management	2.92	1.24
	V73. Our organisation structure is good for internal supply chain integration	2.50	1.17

8. Measurement items for the construct order fulfilment

Please circle the number that best reflects your agreement with the following statements concerning order fulfilment in your hospital. The items were measured using a Likert scale that ranged from 1 (Strongly disagree) to 5 (Strongly agree).

Construct	Measurement item	Mean n=12	Std. Dev.
Order fulfilment	V74.We classify inventories according to their importance	3.50	0.67

	V75.We have collaborative planning, forecasting and replenishment (CPFR)	2.75	1.05
	V76.We make an effort to control ordering costs	3.33	0.89
	V77.Suppliers have capacity to meet the demand	3.75	0.45
	V78.We have capacity to respond to demand fluctuations	3.17	1.27
	V79.We have reduced order fulfilment lead time	3.33	0.65
	V80.We have an inventory policy of maintaining high level of inventory for critical items only	3.08	1.38
	V81.We have an inventory policy for important items	3.08	1.44
	V82.We have inventory policy for all items	2.75	1.6
	V83.We have supplier – buyer integrated order Planning	2.33	0.99
	V84.Suppliers (vendors) manage our inventory	3.25	0.75
	V85.Our deliveries from suppliers are on time and right quantity	3.50	0.52
	V86.We emphasize to suppliers that accuracy and efficiency of order fulfilment is important	4.58	0.52
	V87.We improve supplier performance using order fulfilment metrics (measures)	3.33	0.78
	V88.We have a high stockturn (products are not spending a long time in storage)	3.00	1.21
	V89.We do maintain high levels of emergency supplies	3.08	1.38

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

9. Measurement items for supplier selection

Please prioritize or rate your supplier selection factors on a scale of 1 – 10 (1 : least important and 10 : most important) (circle / tick the number).

Factor	Mean n=12	Std. Dev.
• Cost	8.08	1.93
• Past experience of reliability	7.42	1.88
• Lead time	7.75	1.48
• Reputation / Brand	6.25	1.29
• Quality	9.33	0.49
• Customer service (specialist advice)	8.42	1.24
• Response speed	8.00	1.86
• Flexibility (capacity)	7.58	2.43
• Innovation	6.83	2.44
• Financial position	5.67	2.1

Appendix D

Participant Information Sheet

DATE INFORMATION SHEET PRODUCED:
28 APRIL 2009

PROJECT TITLE

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

AN INVITATION

I am a doctoral student with the Management Department, Business School, at Auckland University of Technology. My PhD research is in the area of supply chain integration in New Zealand public hospitals.

I invite you to participate in this project which involves purchasing and supply personnel in the public hospitals. Your participation would be on a voluntary basis.

WHAT IS THE PURPOSE OF THIS RESEARCH?

The general aims of this project are to:

2. Identify and examine the critical factors that are likely to affect the supply chain integration and their impact on supplier commercial relationships and order fulfilment in the New Zealand public hospital sector
5. Identify existing problems in implementing supply chain integration in public hospitals
6. Develop a model of the critical factors influencing the supply chain integration in the public hospital sector to achieve the order fulfilment goals and improve supplier commercial relationships.

HOW WAS I CHOSEN FOR THIS INVITATION?

You were selected randomly from key people in purchasing and supply working in the public hospitals. You are requested to provide your views about supply chain integration issues in your hospital.

WHAT WILL HAPPEN IN THIS RESEARCH?

The data collected and its analysis will provide an insight on the current supply chain integration practices in public hospitals. The data analysis results could be published in academic journals. The anticipated benefits are indicated below.

WHAT ARE THE DISCOMFORTS AND RISKS?

Potential discomforts and risks are associated with the maintenance of privacy and confidentiality.

HOW WILL THESE DISCOMFORTS AND RISKS BE ALLEVIATED?

The information I ask for is totally anonymous. I don’t need your name and the name of the hospital in a questionnaire and that is why there will be no issues of discomforts and risks regarding privacy and confidentiality.

WHAT ARE THE BENEFITS?

THE FINDINGS FROM THIS STUDY ARE INTENDED TO ENHANCE SUPPLY CHAIN INTEGRATION IN THE PUBLIC HOSPITALS. THE CONTRIBUTION WILL BE THE FOLLOWING:

- The identification of the critical factors influencing supply chain integration in the hospitals.
- The determination of influences on the level of supply chain integration in the hospitals.
- The identification of major factors that improve the service levels in terms of order fulfilment, and reduced supply chain operational costs.
- The identification of key factors that improve the effectiveness of supplier commercial relationships and order fulfilment.

In addition, this study will enhance the current process-based theory by adding other critical factors required to improve supply chain integration in an organisation.

HOW WILL MY PRIVACY BE PROTECTED?

This research does not seek to gather personal information from participants. The questionnaires are anonymous. No hospital / company data will be identified.

WHAT ARE THE COSTS OF PARTICIPATING IN THIS RESEARCH?

THE COST ASSOCIATED WITH YOUR PARTICIPATION IS THE TIME INVOLVED. THE QUESTIONNAIRE WILL TAKE BETWEEN TEN AND FIFTEEN MINUTES TO COMPLETE.

WHAT OPPORTUNITY DO I HAVE TO CONSIDER THIS INVITATION?

Please take a few days to consider this invitation. If you need further information or clarification of any aspects of the project, contact Kabossa Msimangira, (09) 918 4655,

e-mail: kabossa.msimangira@openpolytechnic.ac.nz

Please do remember that your participation is voluntary in this important project.

HOW DO I AGREE TO PARTICIPATE IN THIS RESEARCH?

If you decide to participate by completing the questionnaire, this will be considered as your consent.

WILL I RECEIVE FEEDBACK ON THE RESULTS OF THIS RESEARCH?

A summary report of the findings will be available on request.

The full report will be available as a Thesis from the AUT University Library.

WHAT DO I DO IF I HAVE CONCERNS ABOUT THIS RESEARCH?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisors, *Associate Professor Nevan Wright, Department of Management, Auckland University of Technology, Ph*. (09) 921 9999 ext. 5711, e-mail: nevan.wright@aut.ac.nz

and Dr. Kamrul Ahsan, Department of Management, Auckland University of Technology, Ph. (09) 921 9999 ext. 5477, e-mail: kamrul.ahsan@aut.ac.nz

Concerns regarding the conduct of the research should be notified to the Executive Secretary, AUTEC, Madeline Banda, *madeline.banda@aut.ac.nz*, (09) 921 9999 ext 8044.

WHOM DO I CONTACT FOR FURTHER INFORMATION ABOUT THIS RESEARCH?

Researcher Contact Details:

Kabossa Msimangira, The Open Polytechnic of New Zealand, (09) 918 4655,

e-mail: kabossa.msimangira@openpolytechnic.ac.nz.

Project Supervisors Contact Details:

Associate Professor Nevan Wright, Department of Management, Auckland University of Technology, Ph. (09) 921 9999 ext. 5711, e-mail: nevan.wright@aut.ac.nz

Dr. Kamrul Ahsan, Department of Management, Auckland University of Technology, Ph. (09) 921 9999 ext. 5477, e-mail: kamrul.ahsan@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on 4 May 2009, AUTEC Reference number 07/115.

Survey Questionnaire (Main Study)

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

The completion of this questionnaire is deemed to be consent to participate

Instructions

7. I would like to thank you for your participation in this study
8. Strict confidentiality of respondents will be maintained throughout the project. All responses will be treated as anonymous. Therefore, don't identify yourself and your organisation on this questionnaire, unless you request the summary of the study findings.
9. The questionnaire will take approximately 15 minutes to complete. Please return the completed survey in the self-addressed stamped envelop within 14 days.
10. If you would like a summary of the study findings, please tick the box at the end of the survey and provide me with your private e-mail.
11. If you have any questions regarding the project, please contact me:

Kabossa Msimangira
Kabossa.msimangira@openpolytechnic.ac.nz
Phone number: (09) 918 4655

12. Please return the completed questionnaire to:

Kabossa Msimangira
Auckland Learning Centre
The Open Polytechnic of New Zealand
P.O. Box 6558, Wellesley Street, Auckland 1141

Please answer the following questions in parts A to D using the definition of the "supply chain integration" to mean:

An association of customers and suppliers who, using management techniques, work together to optimize their collective performance in the creation, distribution, and support of an end product. Supply chain integration is a continuous process that can be optimized only when original equipment manufacturers (OEMs), customers, and suppliers work together to improve their relationships and when all participants are aware of key activities at all levels in the chain (National Research Council, 2000, p. 27).
(This definition is also applicable to service organisations).

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 with 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	❑	❑	❑	❑	❑

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. Overall product quality	❑	❑	❑	❑	❑
h. Responsiveness to customer requests	❑	❑	❑	❑	❑
i. Total productivity	❑	❑	❑	❑	❑

4. To what extent have 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	❑	❑	❑	❑	❑
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 circle 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 an 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 importan t
	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

10. Your position / title: …………………………………………

11. Place of work: Hospital ❑ DHB ❑

12. Gender: Male ❑ Female ❑

13. Your highest qualification: Degree ❑ Diploma ❑ Certificate ❑
    Specialisation: …………………………………………………

14. Your procurement responsibility (tick the appropriate box):

    ☐ General requirements

    ☐ Theatre requirements

15. Number of employees in purchasing and supply department ☐

16. Number of key suppliers ☐

17. Annual value of purchases (year 2006/7): NZ$ ……………………………

18. Our hospital buys products and services (tick the appropriate box):

    ☐ direct from the external supplier

    ☐ through agents

THANK YOU FOR YOUR TIME AND ASSISTANCE

FINDINGS

A summary report of the findings will be available on request.

The full report will be available as a Thesis from the AUT University Library.

Appendix E: Hypotheses testing results (E1 – E18)

E1: 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)

E2: 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)	$R^2 = 0.354$ $F = 15.617$		sig (0.000)**	$R^2 = 0.199$ $F = 7.059$		sig (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)

E3: 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)	$R^2 = 0.375$ $F = 11.193$		sig (0.000)**	$R^2 = 0.106$ $F = 2.220$		sig (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)

E4: 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)	$R^2 = 0.051$ F = 1.533		sig (0.225)	$R^2 = 0.021$ F = 0.597		sig (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)

E5: 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)	$R^2 = 0.113$ F = 2.373		sig (0.080)*	$R^2 = 0.153$ F = 3.363		sig (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)

E6: 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)	$R^2 = 0.244$			$R^2 = 0.060$		
	F = 9.199		sig (0.000)**	F = 1.827		sig (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)

E7: 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)	$R^2 = 0.065$ $F = 1.968$		sig (0.149)	$R^2 = 0.231$ $F = 8.559$		sig (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)

E8: 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)	$R^2 = 0.289$			$R^2 = 0.107$		
	F = 11.593		sig (0.000)**	F = 3.408		sig (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)

E9: 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)	$R^2 = 0.039$			$R^2 = 0.258$		
	F = 0.748		sig (0.528)	F = 6.495		sig (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 (< 30)

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

E10: 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)	$R^2 = 0.050$ F = 1.494		sig (0.233)	$R^2 = 0.007$ F = 0.213		sig (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)

E11: 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			R^2 = 0.079		
	F = 4.692		sig (0.005)*	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)

E12: 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	(sig) Significance	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)

E13: 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	(sig) Significance	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)

E14: 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 β	t	(sig) Significance	Standard β	t	Sig	Standard β	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)

E15: 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)		$R^2 = 0.021$ F = 0.599	sig (0.553)	$R^2 = 0.137$ F = 4.515		sig (0.015)**	$R^2 = 0.029$ F = 0.853		sig (0.432)
Items	Standard β	t	(sig.) Significance	Standard β	t	Sig	Standard β	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)

E16: 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 F = 10.432		sig (0.000)**	R^2 = 0.033 F = 0.646		sig (0.589)	R^2 = 0.299 F = 7.977		sig (0.000) **
Items	Standard β	t	(sig.) Significance	Standard β	t	Sig	Standard β	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 information 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)

E17: 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)		$R^2 = 0.083$ F = 2.581	sig (0.085)	$R^2 = 0.222$ F = 8.140		sig (0.001)**	$R^2 = 0.109$ F = 3.497		sig (0.037) *
Items	Standard β	t	(sig) Significance	Standard β	t	Sig	Standard β	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)

E18: 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)		$R^2 = 0.088$ F = 2.742	sig (0.073)	$R^2 = 0.164$ F = 5.597		sig (0.006)**	$R^2 = 0.065$ F = 1.988		sig (0.146)
Items	Standard β	t	(sig) Significance	Standard β	t	Sig	Standard β	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)

Appendix F

Regression model parameters and impact relationships and recommendations (F1 – F15)

F1

Model parameter estimates of focused supply chain integration (service functions are integrated – FCI)

Independent Variables	Model 1 (SI)	Model 2 (ST)	Model 3 (SP)
	Beta (t)	**Beta (t)**	**Beta (t)**
Constant	-1.2E-02 (-0.025)		
SI1 - Cross functional process integration	0.198 (1.452)		
SI2 - Integration with customers	0.499 (3.653)**		
Constant		0.914 (2.220)	
STI - Corporate strategy includes SC1		0.428 (3.658)**	
ST2 - Centralised purchasing department		0.273 (2.335)	
Constant			0.220 (0.389)
SPI – Ability to handle expected challenges			0.420 (2.908)**
SP2 - Lowering cost of purchased items			0.287 (1.935)**
SP3 - Hospital profitability			- 0.076 (-0.617)
R^2	0.422	0.354	0.375
Adjusted R^2	0.401	0.331	0.341
F- value	20.781	15.617	11.193
P-value	0.000**	0.000**	0.000**

Note: * p-value = 0.05
** p-value =0.01

F1 (cont.)

Model parameter estimates of focused supply chain integration (service functions are integrated – FCI)

Independent Variables	Model 4 (SB)	Model 5 (SC)
	Beta (t)	**Beta (t)**
Constant	4.602 (6.471)	
SB1 - Lack of willingness to share information	- 0.320 (- 1.751)	
SB2 - Difficult to establish relationships based on shared risks and rewards	0.006 (0.032)	
SB4 - Inappropriate information systems	- 0.082 (- 0.639)	
Constant		0.820 (1.189)
SCI - Reliable supplies		0.164 (1.185)
SC3- Good process integration between suppliers, customers, and the DHB		0.384 (2.771)**
R^2	0.113	0.244
Adjusted R^2	0.065	0.217
Error	0.881	0.806
F- value	2.373	9.199
P-value	0.080*	0.000**

Note:* p-value = 0.05,** p-value =0.01

F2

Model parameter estimates of focused supply chain integration (follow national procurement policies and procedures - FC2)

Independent Variables	Model 6 (ST)	Model 7 (SB)
	Beta (t)	**Beta (t)**
Constant	2.130(4.416)	
ST1 – Organisation's corporate strategy includes SCI	0.312 (2.393)**	
ST2 – Centralised purchasing department	0.215 (1.649)	
Constant		5.782 (7.906)
SB1 - Lack of willingness to share information		0.058 (0.327)
SB2 - Difficult to establish relationships based on shared risks and rewards		- 0.373 (-2.079)**
SB4 - Inappropriate Information systems		- 0.158 (-1.270)
R^2	0.199	0.153
Adjusted R^2	0.170	0.107
Std Error	0.873	0.906
F- value	7.059	3.363
P-value	0.002**	0.025

Note: * p-value = 0.05
** p-value = 0.01

F3

Model parameter estimates of supplier commercial relationships (reliable suppliers – SC1)

Independent Variables	Model 8 (ST)	Model 9 (SB)
	Beta (t)	**Beta (t)**
Constant	3.144 (11.136)	
ST1 – Organisation's corporate strategy includes SCI	- 0.229 (-1.868)	
ST2 – Centralised purchasing department	0.590 (4.813)**	
Constant		4.918 (11.140)
SB1 - Lack of willingness to share information		0.379 (2.185)
SB2 - Difficult to establish relationships based on shared risks and rewards		- 0.472 (-2.710)
SB4 - Inappropriate Information systems		- 0.280 (-2.315)*
R^2	0.289	0.201
Adjusted R^2	0.264	0.158
Std Error	0.511	0.547
F- value	11.593	4.692
P-value	0.000**	0.005*

Note: * p-value = 0.05
** p-value = 0.01

F4

Model parameter estimates of supplier commercial relationships (good process integration between suppliers, customers and the DHB - SC3)

Independent Variables	**Model 10 (SI)**	**Model 11 (ST)**
	Beta (t)	**Beta (t)**
Constant	1.256 (2.245)	
SI1 - Cross functional process integration	- 0.102 (-0.645)	
SI2 - Integration with customers	0.543 (3.450)*	
Constant		2.240 (4.745)
STI - Organisation's corporate strategy includes SCI		0.141 (1.028)
ST2 - Centralised purchasing department		0.242 (1.760)*
Constant		
SP1 - Ability to handle expected challenges		
SP2 - Lowering cost of purchased items		
SP3 - Hospital profitability		
R^2	0.231	0.107
Adjusted R^2	0.204	0.075
Error	0.793	0.854
F - value	8.559	3.408
P - value	0.001*	0.040*

Note:* p-value = 0.05
** p-value =0.01

F5

Model parameter estimates of order fulfilment (classify inventories according to their importance - OF1)

Independent Variables	Model 13 (ST)	Model 14 (SP)	Model 15 (SB)
	Beta (t)	**Beta (t)**	**Beta (t)**
Constant	2.380 (5.395)		
ST1 - Organisation's corporate strategy includes SCI	0.296 (2.201)**		
ST2 - Centralised purchasing department	0.150 (1.117)*		
Constant		2.571 (4.103)	
SP1 - Ability to handle expected challenges		0.382 (2.220)**	
SP2 - Lowering cost of purchased items		- 0.086 (- 0.486)	
SP3 - Hospital profitability		0.021 (0.141)	
Constant			4.103 (7.272)
SB1 - Lack of willingness to Share information			0.704 (4.534)
SB2 - Difficult to establish relationships based on shared risks and rewards			- 0.861 (- 5.524)**
SB4 – Inappropriate information systems			0.010 (0.093)
R^2	0.147	0.115	0.359
Adjusted R^2	0.117	0.068	0.324
Error	0.799	0.821	0.699
F - value	4.900	2.427	10.432
P - value	0.011**	0.075**	0.000**

Note: * p-value = 0.05
** p-value = 0.01

F6

Model Parameter estimates of order fulfilment (collaborative planning, forecasting and replenishment - OF2)

Independent Variables	**Model 16 (SI)**	**Model 17 (ST)**	**Model 18 (SE)**
	Beta (t)	**Beta (t)**	**Beta (t)**
Constant	1.498 (2.154)		
SI1 - Cross functional process integration	0.243 (1.447)**		
SI2 - Integration with customers	0.143 (0.854)		
Constant		1.477 (2.920)	
STI - Organisation's corporate strategy includes SCI		0.483 (3.824)**	
ST2 - Centralised purchasing department		0.027 (0.214)	
Constant			2.009 (4.111)
SE1 - Suppliers have initiated integration			0.045 (0.304)
SE2 - Customers have initiated integration			0.343 (2.325)**
R^2	0.126	0.245	0.137
Adjusted R^2	0.096	0.219	0.106
Error	0.985	0.916	0.979
F - value	4.127	9.253	4.515
P - value	0.021**	0.000**	0.015**

Note: * p-value = 0.05
** p-value = 0.01

F6 (cont.)

Model Parameter estimates of order fulfilment (collaborative planning, forecasting and replenishment - OF2)

Independent Variables	Model 19 (SC)	Model 20 (FC)
	Beta (t)	**Beta (t)**
Constant	0.382 (0.480)	
SC1 - Reliable suppliers	0.302 (2.149)**	
SC3 - Good process integration between suppliers, customers, and the DHB	0.231 (1.647)**	
Constant		2.543 (4.450)
FC1 - Service functions are integrated		0.450 (3.345)**
FC2 - Follow national procurement policies and procedures		- 0.196 (-1.448)
R^2	0.222	0.164
Adjusted R^2	0.195	0.135
Error	0.929	0.964
F - value	8.140	5.597
P - value	0.001**	0.006**

Note: * p-value = 0.05
** p-value = 0.01

F7

Model Parameter estimates of order fulfilment (an effort to control ordering costs – OF3)

Independent Variables	**Model 21 (SP)**	**Model 22 (SB)**	**Model 23 (SC)**
	Beta (t)	**Beta (t)**	**Beta (t)**
Constant	1.928 (3.319)		
SP1 - Ability to handle expected challenges	-2.48 (-1.708)		
SP2 - Lowering cost of purchased items	0.085 (0.568)		
SP3 - Hospital profitability	0.647 (5.213)**		
Constant		3.896 (6.019)	
SB1 - Lack of willingness to share information		0.516 (3.182)**	
SB2 - Difficult to establish relationships based on shared risks and rewards		- 0.034 (- 0.191)	
SB4 - Inappropriate Information systems		- 0.362 (- 3.190)*	
Constant			2.570 (3.353)
SC1 - Reliable suppliers			0.372 (2.477)
SC3 - Good process integration between suppliers, customers, and the DHB			- 0.322 (- 2.146)*
R^2	0.369	0.299	0.109
Adjusted R^2	0.335	0.262	0.078
Error	0.761	0.801	0.896
F - value	10.921	7.977	3.497
P - value	0.000**	0.000**	0.037*

Note: * p-value = 0.05
** p-value = 0.01

F8

Impact of critical SCI operational issues on supplier commercial relationships (SCI, SC3)

SCI Operational Issues		**Pearson Impact on SC1**	**Correlation Impact on SC3**
SI1	Cross functional process integration	0.252	0.265*
SI2	Integration with customers	0.195	0.475*
ST1	Corporate strategy includes SC1	0.015	0.241
ST2	Centralised purchasing department	0.496**	0.300*
SP1	Ability to handle expected challenges	0.055	0.262
SP2	Lowering cost of purchased items	0.069	0.424**
SP3	Hospital profitability	- 0.121	- 0.034
SE1	Suppliers have initiated integration	- 0.223	0.007
SE2	Customers have initiated integration	- 0.136	0.075
SB1	Lack of willingness to share information	0.000	- 0.273*
SB2	Difficult to establish relationships based on shared risks and rewards	- 0.243	- 0.094
SB4	Inappropriate Information systems	- 0.307	- 0.182

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

Note: SC1 = Reliable suppliers

SC3 = Good process integration between suppliers, customers and the DHB

F9

Impact of critical SCI operational issues on order fulfilment (OF1, OF2, OF3)

Operational Issues		**Pearson Impact on OF1**	**Correlation Impact on OF2**	**Impact on OF3**
SI1	Cross functional process integration	0.098	0.340**	0.093
SI2	Integration with customers	0.090	0.307*	0.068
ST1	Corporate strategy Includes SC1	0.358**	0.494**	0.113
ST2	Centralised purchasing department	0.272*	0.227	0.274*
SP1	Ability to handle expected challenges	0.334**	0.242	0.100
SP2	Lowering cost of purchased items	0.179	0.199	0.238
SP3	Hospital profitability	0.150	0.212	0.577**
SE1	Suppliers have initiated integration	0.109	0.234	0.140
SE2	Customers have initiated integration	-0.018	0.368**	0.159
SB1	Lack of willingness to share information	0.082	0.096	0.403**
SB2	Difficult to establish relationships based on shared risks and rewards	-0.350	0.037	0.225
SB4	Inappropriate Information systems	-0.037	-0.139	-0.308

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

Note: OF1 = Classify inventories according to their importance
OF2 = Collaborative planning, forecasting and replenishment
OF3 = An effort to control ordering costs

F10

Impact of critical SCI operational issues on commercial relationships (FC1, FC2)

Operational Issues		Pearson Correlation Impact on FC1	Pearson Correlation Impact on FC2
SI1	Cross functional process integration	0.535**	0.124
SI2	Integration with customers	0.633**	0.078
ST1	Corporate Strategy Includes SC1	0.541**	0.400**
ST2	Centralised purchasing department	0.450**	0.344**
SP1	Ability to handle expected challenges	0.577**	0.268*
SP2	Lowering cost of purchased items	0.530**	0.243
SP3	Hospital profitability	0.254	0.002
SE1	Suppliers have initiated integration	-0.010	0.064
SE2	Customers have initiated integration	0.182	0.142
SB1	Lack of willingness to share information	-0.326*	-0.232
SB2	Difficult to establish relationship	-0.239	-0.356**
SB4	Inappropriate Information	-0.123	-0.211

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

Note: FC1 = Service functions are integrated
FC2 = We follow national procurement policies and procedures

F11

Impact of supplier commercial relationships on focussed SC1 (FC1, FC2)

Supplier Commercial Relationships		Pearson Correlation Impact on FC1	Pearson Correlation Impact on FC2
SC1	Reliable suppliers	0.377**	0.240
SC3	Good process integration between suppliers, customers, and the DHB	0.475**	0.177

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

Note: FC1 = Service functions are integrated
FC2 = We follow national procurement policies and procedures

F12

Impact of supplier commercial relationships on order fulfilment (OF1, OF2, OF3)

Supplier Commercial Relationships		**Pearson Correlation**	
	Impact on OF1	**Impact on OF2**	**Impact on OF3**
SC1 - Reliable suppliers	0.288**	0.430**	0.193
SC3 - Good process integration between suppliers, customers, and the DHB	0.168	0.399**	- 0.116

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

Note: OF1 = Classify inventories according to their importance
OF2 = Collaborative planning, forecasting and replenishment
OF3 = An effort to control ordering costs

F13

Impact of focused SC1 on order fulfilment (OF1, (OF1, OF2, OF3)

Supplier Commercial Relationships		**Pearson Correlation**	
	Impact on OF1	**Impact on OF2**	**Impact on OF3**
FC1 - Service functions are Integrated	0.272*	0.365**	0.253
FC2 - Follow national procurement policies and procedures	0.227	0.006	0.145

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

Note: OF1 = Classify inventories according to their importance
OF2 = Collaborative planning, forecasting and replenishment
OF3 = An effort to control ordering costs

F14

Supplier selection

Factors	Mean	Std. Deviation	Rank
Quality	4.500	0.597	1
Cost	4.167	0.717	2
Customer Service (specialist advice)	4.117	0.804	3
Past experience of reliability	3.967	0.780	4
Lead time	3.950	0.699	5
Response speed	3.850	0.840	6

F15

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